Self-regulation in sport and education

Jonker, Laura

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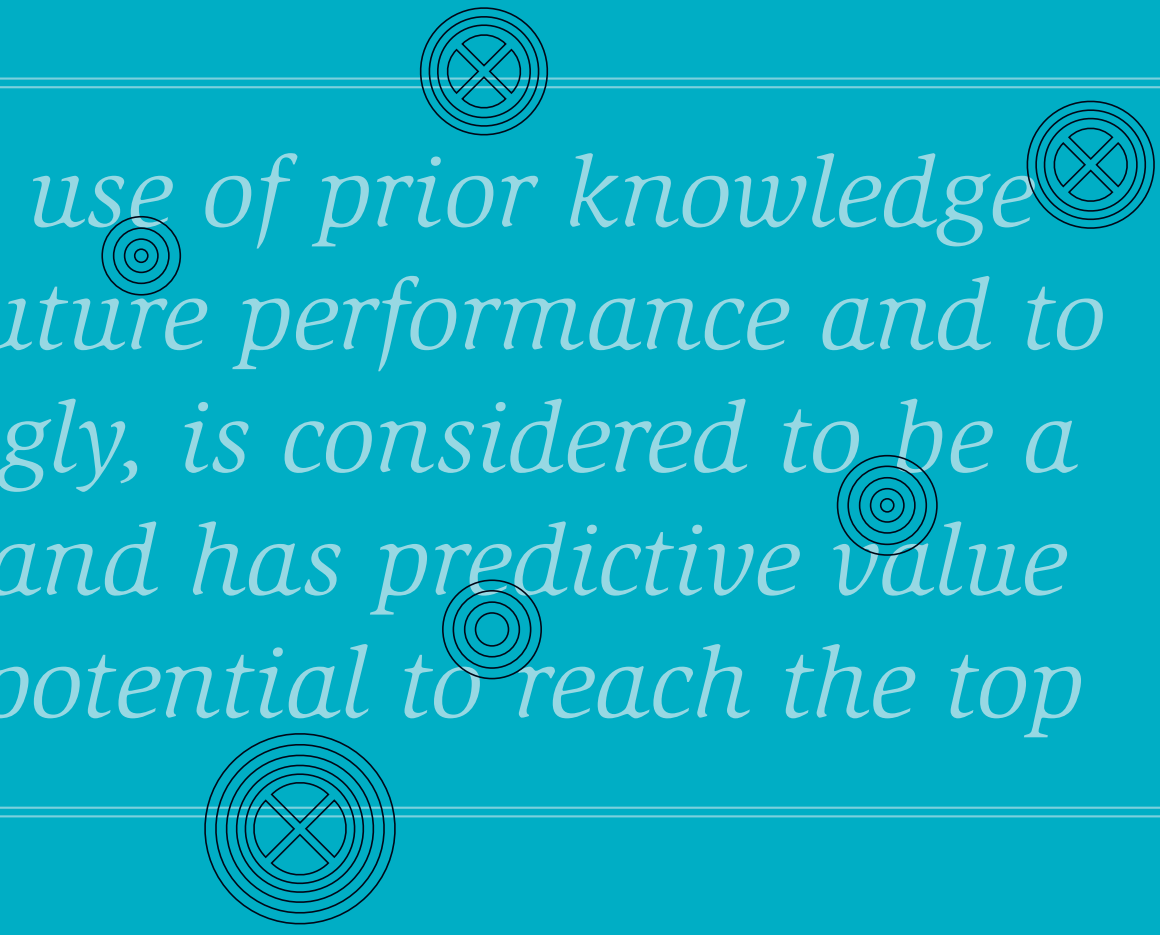
Important for sport expertise and academic achievement for elite youth athletes

Laura Jonker



Stellingen

Behorende bij het proefschrift
Self-regulation in sport and education - Important for sport expertise and academic achievement for elite youth athletes
Laura Jonker, 21 december 2011

1. Elite youth athletes, including soccer players, are academic high achievers (this thesis).

2. Strong self-regulatory skills may be essential for performance at the highest levels of sport competition in combination with academia (this thesis).

3. Tell me and I forget, show me and I remember, involve me and I understand (Ancient Chinese Proverb).

4. Zelfregulatie: meerwaarde van en voor de sport.

5. Sports participation is important for the development of self-regulatory skills (this thesis).

6. Reflection can help to predict who is going to reach the top as a key factor in the development of sport expertise (this thesis).

7. Leren is niet de wet der herhaling, maar proactief en efficiënt omgaan met het aantal herhalingen.

8. If you always do what you have always done, you will always get what you have always got (Henry Ford, 1863-1947).

9. *Ever* change a winning team (Alex Ferguson).

10. The beautiful thing about learning is that no one can take it away from you (B.B. King).

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Self-regulation in sport and education

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Content

Chapter 1

Introduction

11

Introduction

Sports in modern society

Sport has become increasingly important in the last decade. This is illustrated by the efforts of the Netherlands to organize the Olympic and Paralympic games in 2028. The value of sports participation has been expressed in several ways in various contexts, for example in health and social developmental perspectives (NCRIM, 2002), and in academic research (this dissertation). Which athletes reach the levels of expertise that millions of people will be watching with astonishment? Who are the athletes who can serve as role models for the youth and encourage them to be active in sports? What characterizes the successful ones? How did they learn to perform at this exceptional level? Can we facilitate them on their way to the top, and how can we benefit from their way of learning and performing?

An elite youth athlete striving for the top

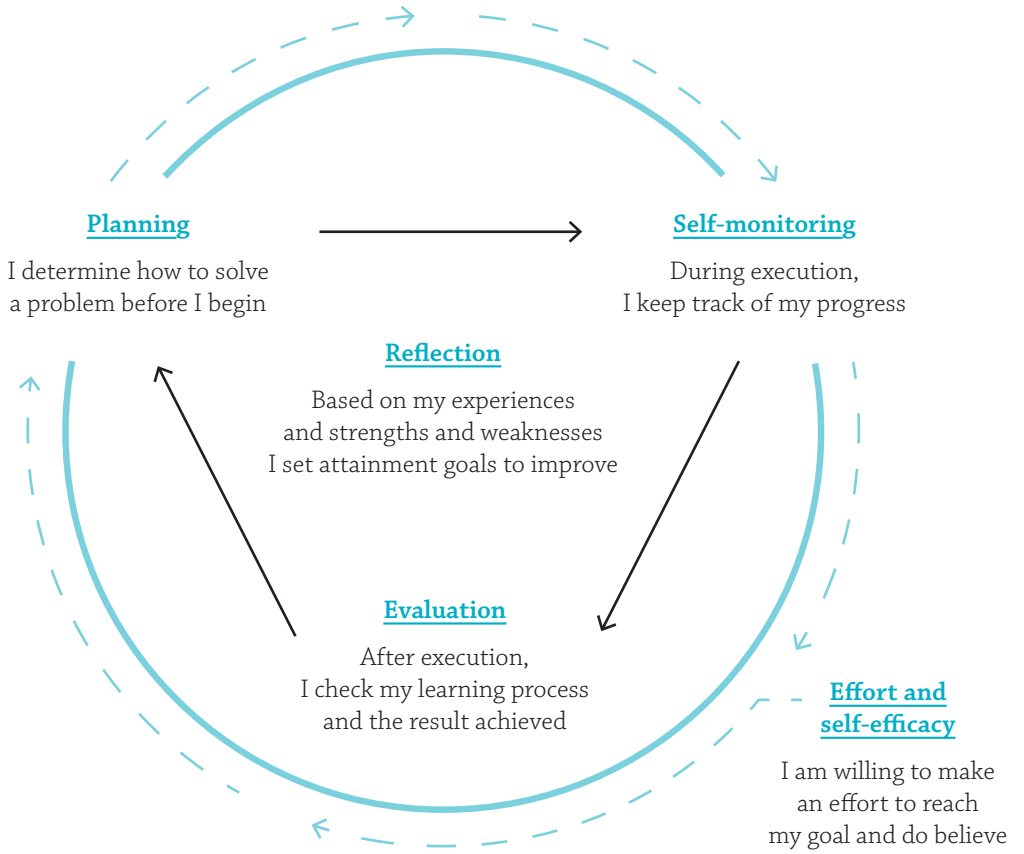
Previous research has revealed that for athletes to reach expert levels of performance, investing about 10,000 hours over a time period of 10 years is not unusual (Ericsson, 1996; Ericsson, Krampe, & Tesch-Römer, 1993). In this restricted time period, youth athletes must improve their sport-specific characteristics enough to be able to compete at a high standard not only as juniors but to reach senior elite levels in their sport as well. In the Netherlands it is common for youth athletes who outperform their peers during training and competition and those who may have the potential to reach the top to form part of talent development programs or selection teams. This means that they belong to the best 1% (junior internationals) to 2.5% (junior nationals) of athletes in their age category and that they are facilitated with extra training facilities, highly certified trainers, medical supervision, and special provisions at school (NOC*NSF; Elferink-Gemser, Jordet, Coelho-E-Silva, & Visscher, 2011). Their years in these talent development programs (most often when the athletes are between 12 and 18 years of age) are extremely important as the most progression must be made in sport in this period; but this is also the phase when several important changes occur in psychological and academic areas (Brettschneider, 1999; Wylleman, Alfermann, & Lavallee, 2004). They have to juggle their academic careers with the extensive investment in their sport. It therefore seems important that youth athletes learn to balance their activities effectively and to attain senior elite status efficiently.

Theoretical framework

The value of the use of self-regulatory skills has been emphasized both in sport and academic domains as a means to learn more efficiently and to improve performance. Cleary and Zimmerman (2001) for example showed that expert athletes are better able to set specific attainment goals and to select the most appropriate strategy to achieve these self-set goals. In secondary education, more successful students, for example those in the higher academic levels, with higher grade point averages and better graduation rates, display an increased use of self-regulatory skills compared with their less successful peers (e.g., Cleary & Chen, 2009; Miller, 2000; Nota, Soresi, & Zimmerman, 2004). The frequent use of self-regulatory skills seems to make people in general better able to structure their learning environments so they can benefit optimally from the time spent on learning. For the purposes of this study, self-regulation is

expressed in line with Zimmerman's definition as the extent to which individuals are metacognitively, behaviorally and motivationally proactive participants in their learning processes (Zimmerman, 1986, 2006). Based on Zimmerman's (2000) self-regulated learning theory, we assume that the self-regulatory process is subdivided into several skills that are cyclically related (Figure 1).

Figure 1. The self-regulatory process in phases.



In recent decades, several researchers have discussed whether self-regulatory skills are domain specific or whether people are able to transfer their self-regulatory skills between performance domains (i.e., domain general skills). Studies have shown that self-regulatory skills are suggested to develop as domain-specific strategies from an early age of approximately 2 to 6 years. When people

reach the age of 12 they are thought to be able to use self-regulatory skills consciously and their skills seem to have become more domain general (Van der Stel & Veenman, 2008; Veenman & Spaans, 2005; Zelazo & Müller, 2002), which means that they can be applied to different performance domains. In addition, the use of self-regulatory skills can be prompted (e.g., Cleary, Platten, & Nelson, 2008; Peters & Kitsantas, 2010). In this perspective, the use of self-regulatory skills seems especially valuable for elite youth athletes striving for the top, as these skills not only help them to benefit most from the time spent on learning, but can also serve them in combining their academic careers with the extensive investment in sport.

Research population

Results of this thesis are based on measurements obtained from approximately 3000 participants between 11 and 18 years of age in the period 2006-2010. Comparisons were made between the participants as they were subdivided on the basis of their competitive and/or academic levels. In the literature, various terms have been used to refer to self-regulation, the competitive level of athletes and the academic performance of students. In this dissertation, we use the terms *talented athletes* or *elite youth athletes* when we refer to youth athletes who are identified as physically very gifted and are believed to possess an above average potential to reach the top and are part of a talent development program in the Netherlands (i.e., the best 1%-2.5% of athletes in their age category). To discriminate between good athletes (best 2.5%) and the best athletes (best 1%), the terms *nationals* and *internationals* at junior or senior age have been used in chapters seven to nine. In chapters three to six, comparisons have been made between elite youth athletes and *regional athletes* (i.e., participants in competitive sports, but not identified as talented), *non-athletes* (i.e., not playing sports at all), and *mainstream* or *typical students* (i.e., students are expected to represent a regular sample of Dutch students).

With regard to academic performance, all youth in the Netherlands are part of an academic system that is subdivided into several academic levels. In this dissertation these levels have been combined into two academic systems on the basis of their content and international comparability. Thus, participants have been classified as being part of the *pre-university* system, which prepares students for a future university career, or the *pre-vocational* system, which prepares students for later vocational education (The Netherlands Inspectorate of Education, 2008).

Rationale and research questions

The purpose of the dissertation is to assess the role of self-regulatory skills in the sport and academic performances of elite youth athletes aged between 12 and 18 years. This dissertation attempts to answer several research questions, such as: 1) What is the relationship between the sport and academic performances of elite youth athletes? 2) What is the role of self-regulatory skills in the relationship between sport and academic performances? 3) How do self-regulatory skills develop in youth (12-17 years) and how are they related to sport and academic performances? 4) Which self-regulatory skills are most frequently used by junior internationals and junior nationals and do these skills have predictive value for attained senior competitive level? 5) How do these skills develop in junior internationals and junior nationals (aged 12-18)?

Thesis outline

In chapter 2 the importance of self-regulatory skills in the sport and academic domains for youth between 12 and 18 years is addressed. Chapter 3 focuses on the question of whether in a historical perspective elite youth athletes are not only athletic high achievers but academic high achievers as well. The percentage of elite youth athletes in the pre-university system in 2006/2007 is compared to the percentage of mainstream students (expressed by the national average) capable of taking part in this academic system. A similar analysis was performed for elite youth athletes in 1992/1993 and the national average of that year. We then compared the percentage of elite youth athletes in the pre-university system in 2006/2007 with the percentage of youth athletes in this academic system 14 years earlier (in 1992/1993) to define a historical perspective.

Chapter 4 examines the role of self-regulatory skills in the relationship between sport and academic performances by comparing elite youth athletes with a sample of non-athletes in either the pre-university or pre-vocational system. Scores on a self-reporting instrument for self-regulatory skills were assessed, as it was assumed that the use of self-regulatory skills may underlie sport and academic performances.

In chapter 5 the methodology of the third and fourth chapters was repeated for a population of elite youth soccer players, as the prevailing stereotype is that soccer players are low academic achievers. Again, the academic levels and self-regulatory skills of elite youth soccer players is compared to that of age-matched mainstream students.

Chapter 6 investigates the development of the use of self-regulatory skills in youth aged 12 to 17 years. The effects of sport and academic-related data on the development of these skills were assessed among elite, regional and non-athletes to provide us with new leads regarding how to support children in developing and using self-regulatory skills.

Chapter 7 addresses the relationship between the use of self-regulatory skills and elite youth athletes considered to be internationals or nationals. As type of sport (team or individual) may affect this relationship, we assessed possible differences between athletes playing team sports and those taking part in individual sports.

In chapter 8, the self-reported use of reflection by junior internationals and junior nationals was assessed 2.5 years before transition and related to attained senior competitive level (international or national). The junior internationals and junior nationals were matched on training characteristics and age.

Chapter 9 addresses the question of how reflection develops in the four-year period before transition and how this development is related to the attainment of senior international status. The results provide insight into the value of reflective thinking during different phases of expertise development.

As the results of this dissertation have been obtained by the use of the Self-Regulation of Learning – Self-Report Scale (SRL–SRS), chapter 10 assesses the reliability and validity of the SRLS–SRS among youth between 11 and 17 years of age.

In chapter 11, the findings from the above-mentioned studies are discussed, conclusions are presented as well as practical implications and recommendations for future research.

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Chapter 2

The role of self-regulatory skills in sports and academia: a systematic review

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Abstract

This study reviews papers related to the use of self-regulatory skills in 12-to-18-year-old youth. Their use of these skills was related to their sport and/or academic performance. The purpose of this study was to examine whether self-regulatory skills can serve as an underlying feature in sport and academia, and whether there are differences in these self-regulatory skills that seem to distinguish best between high and low achievers in sport or academia. Thirty-nine papers were included in the present study. Their methodological quality was determined, their results summarized and the authors' conclusions presented. We found that there are variations in concept, definition and measurement of self-regulation. Furthermore, although the use of self-regulatory skills is beneficial for performance in the sport and academic domains, the possibility for the transfer of self-regulatory skills between sports and academia has not yet been examined. In this perspective, children from approximately 12 years of age are assumed to be able to use more domain-general self-regulatory skills between performance domains. In the academic setting, intervention studies showed that self-regulatory skills can be cued and prompted. The sport context is suggested as a suitable environment in which to develop and prompt students to use self-regulatory skills. Specifically, self-monitoring and reflection were found to be predictive for academic achievement. Reflection, effort and self-efficacy have been mentioned as most important in the sport setting; however, no studies were found that could predict sport performance based on the self-regulatory skills mentioned by the athletes.

Jonker, L., Elferink-Gemser, M. T., & Visscher, C. The role of self-regulatory skills in sports and academia: A systematic review. *(Submitted)*

Introduction

Self-regulation has been widely studied in several domains such as in academia (e.g., Zimmerman, 1986, 1998, 2002), sports (e.g., Cleary & Zimmerman, 2001), physical education (Kitsantas & Zimmerman, 1998), and music (Nielsen, 2001). This has led to several definitions and concepts which are in fact closely related, but difficult to compare. In 1986 a uniform definition of self-regulation appeared in literature which can be applied between the different learning domains under study. Based on theories of metacognition,

learning strategies, volitional strategies, self-concept, and self-control, self-regulation was now described as the degree to which students are metacognitively, motivationally and behaviourally proactive participants in their own learning process (Zimmerman, 1986, 2006). Metacognition is defined as awareness of and knowledge about one's own thinking. Motivation is considered as the degree to which learners are self-efficaciously, autonomously and intrinsically motivated to achieve a specific goal. In addition, learners must not only be familiar with and be motivated to use metacognitive skills, the use of these skills should be expressed in behaviour (Zimmerman, 1986, 1990, 2006). In this way, students are supposed to tackle their learning tasks proactively (behaviour) using their self-regulatory skills (metacognition and motivation) to improve their performance efficiently.

The most commonly used model in the self-regulatory literature is Zimmerman's (2000) self-regulated learning model. In this model Zimmerman distinguishes three cyclical phases of self-regulation, the forethought phase, the performance phase and the self-reflection phase. The forethought phase is described as the stage at which processes and beliefs come to mind before learning. Subprocesses and beliefs in the forethought phase include skills such as goal-setting and planning. As students must also be motivated to learn and have confidence in their expected outcome, skills such as motivation, effort and self-efficacy were included as well (Zimmerman, 2000, 2002). The performance phase is described as the stage at which processes occur during learning. Subprocesses of the performance phase include skills such as self-control and self-observation. The self-reflection phase is described as the stage at which processes and beliefs are formed after learning. Subprocesses and beliefs of the self-reflection phase include self-judgement and self-reaction (Zimmerman, 2000, 2002).

Zimmerman's (2000) self-regulated learning model was first applied in relation to low and high achievers in academia. Zimmerman and Martinez-Pons (1986), for example, showed that students in higher academic tracks report using several self-regulated learning subprocesses more frequently than students in lower academic tracks. In addition, students in lower academic tracks tended to use more strategies that were classified as non-self-regulated (Zimmerman, 1990; Zimmerman & Martinez-Pons, 1986). Later on, the model was applied to the sport setting as well. The value of the use of self-regulatory skills was presented in learning a new motor skill (Kitsantas & Zimmerman, 1998), and can be used to discriminate between athletes at different competitive levels (experts, non-experts and novices; Cleary & Zimmerman, 2001).

With regard to the development of self-regulatory skills, it is known that these skills do not occur naturally. People are best able to develop self-regulatory skills in an inspiring environment in which goal-setting and feedback play a role (Boekaerts, 1997; Boekaerts & Corno, 2005). In addition, the ability to self-regulate is founded on experience in learning and development, which means that learners have access to sufficient domain-specific (declarative and procedural) knowledge bases (Pintrich & Zusho, 2002). Declarative knowledge comprises domain-specific knowledge in the form of factual information, such as the rules of a game in sports (Anderson, 1982, French & Thomas, 1987; Williams & Davids, 1995). Procedural knowledge comprises the procedures concerning how and when to accomplish a specific

task, such as the execution of an appropriate action during the game (Anderson, 1982; French & Thomas, 1987; Williams & Davids, 1995). In recent decades there has been continuous discussion on whether performance in a specific domain is more related to a person's domain-specific knowledge, or whether more domain-general skills facilitate mastery (Perkins & Salomon, 1989). The conclusion seems to rely on the fact that domain specific knowledge bases help to develop self-regulatory skills, whereas self-regulatory skills can be thought of as general skills from which to extend the domain-specific knowledge base (Perkins & Salomon, 1989; Pintrich & Zusho, 2002). Nevertheless, there is still discussion regarding whether there are possibilities for successful transfer of self-regulatory skills between domains.

With respect to the possibility of the transfer of self-regulatory skills, there is also a long history of debate about whether it is possible to apply self-regulatory skills achieved in one domain to progress performance or learning efficiently in another. In the literature, many failures of transfer have been reported, but many successes of transfer have been presented as well (Perkins & Salomon, 1989). These differences may be related to the conceptualization of 'successful transfer' and also to the distance of transfer between domains. More specifically, some researchers consider transfer as successful when knowledge obtained in one domain is independently and instantly used in another domain, while other researchers take a broader view and consider successful transfer as knowledge obtained in one domain fostering the use of skills in another domain (De Corte, 2003). With regard to the distance of transfer between domains, Brainerd (1975) distinguished a three-level proximity criterion: near-near transfer (when tasks or domains are nearly identical), near-far transfer (when tasks or domains required similar cognitive processes but are different), and far-far transfer (when tasks or domains are very different in content and require cognitive processes) (Brainerd, 1975; Sanz de Acedo Lizarraga, Sanz de Acedo Baquedano, & Pollán Rufo, 2010b).

From a talent developmental perspective, the ability to use self-regulatory skills, and the possibility to use these skills within and between performance domains, may be particularly important for elite youth athletes striving to attain senior elite status. During their years as youth athletes (between 12 and 18 years of age in most sports), athletes are faced with several important life transitions on psychological, psychosocial, athletic and academic levels (Wylleman, Alfermann, & Lavallee, 2004). At the academic and psychological levels, a relatively major life event occurs when children are approximately 12-13 years of age and have to transfer from primary to secondary school, which is also the period when students enter puberty. The use of self-regulatory skills may help to overcome the stress accompanied with these events (Aspinwall & Taylor, 1997; Moon, 2003). On the athletic level, it is suggested that children reach their specializing years at the age of about 13 (ages 13-15 in most sports; Côté, 1999). According to Ericsson and colleagues' (1993) theory of deliberate practice, athletes have to commit to sustained and effortful practice sessions for at least 10 years in a row to reach the top. During deliberate practice, athletes progress through several developmental stages (sampling, specializing and investment years) and these stages of development are characterized by an increase in the hours devoted to training (Côté, 1999; Ericsson, Krampe, & Tesch-Römer, 1993).

When athletes are approximately 16 years of age, another important transition point occurs at athletic and academic levels. Athletes need to make the decision to become elite athletes and as a result need to spend most of their leisure time on training (the investment years; Côté, 1999). On the academic level, students have to choose the direction for their future academic orientation as well (Wylleman et al., 2004). Domain-general self-regulatory skills may help youth athletes to focus on those aspects of learning that seem most important to them to achieve their goals.

For the purpose of this study, we sought to gain a systematic overview of self-regulatory literature in the domains of sport and academia in youth between 12 and 18 years of age. More specifically, we tried to examine whether youth with the highest levels of self-regulation are also classified as high athletic or academic achievers. The definition of self-regulation which presumes that people are proactively engaged in their learning process in a metacognitive, motivational and behavioural sense was adopted (Zimmerman, 1986, 2006). The two research questions to be answered were 1) whether self-regulatory skills can serve as an underlying characteristic of performance in sport and academia in youth aged 12 to 18 years, and 2) whether there are differences in the self-regulatory skills that contribute the most to performance in sports or academia (i.e., which of these skills seem to be most important within each domain).

Method

Search strategy

The ERIC, PsycINFO, Pubmed, Web of Sciences and CINAHL databases were searched for relevant information. The search was executed in September 2009 and included all citations that were available in the database at that time. We conducted an update search in January 2011 to also include relevant studies that were published in the last months of 2009 and in 2010. The databases were searched for records that contained one of the following combinations of terms (1 AND 2 [AND 3]):

1. *Self-regulation* (OR self-regulated learning OR self-monitoring) *OR metacognition OR learning strategies* (OR learning transfer)
2. *Talented athletes* (OR athletic training OR athletic participation OR college athletes OR athletes) *OR sport performance* (OR athletic performance OR sports) *OR sport expertise* OR *elite athletes*
3. *Academic performance* (OR educational standards OR academic achievement OR school learning) *OR graduation* (OR school graduation OR college graduates OR graduate education OR graduate students OR high school graduates)

The italicized terms are the key terms (e.g., Medical Subject Headings [MeSH]). As the ERIC, PsycINFO, Web of Sciences and CINAHL databases do not have such a key term registry, the search strategy was modified for these databases.

Inclusion criteria

A study had to meet several criteria to be included in this review. To be included, the studies had to: 1) provide a measure of self-regulation, 2) provide a measure of competitive level (not physical education), or 3) provide a measure of academic achievement, 4) provide a correlation between self-regulatory skills and either competitive level or academic achievement, 5) report the results of adolescents between 12 and 18 years of age (when age was not mentioned students had to be in secondary education), 6) and studies had to be published in English. Additionally, due to conceptual and operational overlap between measures of self-regulation within the sport and academic domains, studies were included that measured any concept related to self-regulation (e.g., learning strategies, self-monitoring, self-efficacy). Studies on specific aspects of self-regulation such as planning and self-efficacy were not searched for, but were included when found.

Exclusion criteria

Dissertations and book chapters were excluded. Other exclusion criteria were studies conducted in non-Western cultures (e.g., Asian, Arabian, etc.) as research has shown differences in the self-regulatory skills between cultures (e.g., Purdie & Hattie, 1996; Rao, Moely, & Sachs, 2000), and studies conducted in computer-oriented or web-based environments as Zimmerman (2008) has already published a review on self-regulated learning and innovative online measurements (computer traces, think-aloud protocols, diaries of studying, direct observation and microanalysis). Additionally, studies with special populations (e.g., learning difficulties and low intelligence quotient [IQ]) were also excluded.

Remaining papers

The initial search yielded over 10,000 results, which required us to use appropriate restriction strategies beforehand within the databases. We restricted our initial search by publication type (only peer reviewed journals), age (adolescents between 12 and 30 years of age as this was the only option to select), and language (only studies in English) which yielded 7108 results. The remaining titles were scanned for relevance by the first two reviewers (LJ & MEG), which resulted in 769 relevant titles. Of this total of 769, the abstracts were read and judged for potential relevance by the same two reviewers (LJ & MEG), reducing the total to 283 studies. A third blind reviewer (CV) checked at random the abstracts of 20 papers, 10 of which had been included and 10 excluded by the first two reviewers. Questions about one paper were resolved by discussion. As too many studies remained, we decided to exclude studies that were not published in journals with an impact factor (n = 60) and to exclude all studies that were not published in the last 15 years (i.e., between January 1995 and December 2010; n =14). Eventually, 209 papers were selected to determine whether they met all inclusion criteria.

When reading the body of the 209 papers, 163 papers were rejected on the basis of exclusion criteria (see above) that could not have been distilled from the abstract. Important reasons for rejecting studies included lack of self-regulatory measure (n = 7), lack of a measure of competitive sport level (n = 14), lack of a measure for academic achievement (n = 33), or due to the age of the participants (n = 62; i.e., they were not between 12 and 18 years of age). Forty-seven papers were excluded on the basis of one of the other exclusion criteria, such as testing a model, review articles, articles conducted in the physical education setting or studies that did not show a direct relationship between self-regulatory skills and sport or academic performance.

Methodological quality

A total of 46 studies met the inclusion criteria and were scored on methodological quality using Critical Review From–Quantitative Studies (Law, Stewart, Pollock, Letts, Bosch, & Westmorland, 1998). This process was chosen to evaluate the methodological quality according to 9 main categories: 1) study purpose, 2) literature review, 3) study design, 4) sample, 5) outcomes, 6) intervention (where applicable), 7) results, 8) conclusion, and 9) implications. Sixteen closed-ended questions were used to assess the overall quality of the studies. The answer-categories on the 16 questions were either 1 (completely satisfies the criterion), 0 (does not satisfy the criterion), ? (unclear), or NA (not applicable). The scores on all 16 questions were totalled for each study which resulted in scores between 0 and 16 (15 when no intervention was involved in the study). Studies with scores above 12 were regarded as having high methodological quality, whereas studies with scores below 7 were considered as studies with low methodological quality. The methodological quality of the studies was scored by two reviewers (LJ & MEG). Inconsistency between the reviewers was resolved by discussion. Only studies with sufficient methodological quality (above 6) were included in the results section of this study. Based on methodological quality 7 studies were excluded. Table 1 shows the methodological quality of the research papers.

Table 1. Results of the methodological quality (MQ) of the studies examining variables associated with aspects of self-regulation, measures of sport performance level and measures of academic achievement according to the Critical Review Form – Quantitative Studies (CRF-QS; Law et al., 1998. Studies were rated by two of the authors (LJ & MEG).

Studies	CRF-QS																Methodological quality
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total	
1. Anshel (1995)	1	1	1	1	1	0	0	0	0	NA	1	1	1	1	1	0	10	Middle
2. Ansel & Porter (1996)	1	1	1	1	1	1	0	0	0	NA	1	1	0	1	0	0	9	Middle
3. Bakracevic Vukam & Licardo (2010)	1	1	1	0	0	0	0	1	0	NA	1	1	0	0	0	0	6	Low
4. Barkley (2006)	1	1	1	0	1	1	1	1	0	NA	0	1	1	0	1	0	10	Middle
5. Ben-David & Zohar (2009)	1	1	1	1	1	1	0	?	?	1	1	1	1	1	1	1	13	High
6. Bergin (1996)	1	1	0	1	1	1	0	0	?	NA	1	?	1	0	1	1	9	Middle
7. Caprara et al. (2008)	1	1	1	1	1	0	1	1	1	NA	1	1	1	1	1	0	13	High
8. Cleary & Chen (2009)	1	1	1	0	1	1	1	1	1	NA	1	1	1	1	1	1	14	High
9. Cleary & Zimmerman (2001)	1	1	1	1	1	0	1	1	1	NA	1	1	1	1	1	0	12	High
10. Cleary et al. (2008)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	High
11. Conner (2007)	0	0	1	1	0	0	0	0	0	0	0	?	1	1	1	1	6	Low
12. Conner & Gunstone (2004)	1	0	1	1	0	0	0	0	0	0	0	?	1	0	0	1	5	Low
13. Eshel & Kohavi (2003)	1	1	1	0	1	0	0	1	0	NA	1	?	1	1	1	0	9	Middle
14. Grum et al. (2004)	1	1	0	1	0	0	0	1	0	NA	0	?	0	1	0	0	5	Low
15. Jones & Lavallee (2009)	1	1	1	0	1	0	1	1	1	NA	0	0	1	1	1	1	11	Middle
16. Jonker et al. (2010a)	1	1	1	1	1	0	1	1	0	NA	1	1	1	1	0	1	12	High
17. Jonker et al. (2010b)	1	1	1	1	1	0	1	1	0	NA	1	1	0	1	0	1	11	Middle
18. Lan (2005)	1	1	1	1	0	0	0	0	0	NA	1	?	1	0	1	0	7	Middle
19. Martín et al. (2008)	1	1	1	0	1	0	0	1	0	NA	1	?	1	1	0	0	8	Middle
20. Meneghetti et al. (2007)	1	1	1	1	0	0	0	1	0	NA	1	1	1	1	1	0	10	Middle
21. Mevarech & Kramarski (2003)	0	1	1	1	0	0	0	1	0	1	1	1	1	1	1	1	11	Middle
22. Miller (2000)	1	1	1	0	1	0	1	1	0	0	1	1	1	1	1	1	12	High
23. Miller & Byrnes (2001)	1	1	1	0	0	0	0	1	1	NA	1	?	1	1	0	0	8	Middle
24. Moore & Scevak (1995)	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	13	High
25. Nota et al. (2004)	1	1	1	0	1	1	0	0	1	NA	1	?	1	1	1	1	11	Middle
26. Pajares & Valiante (1999)	1	1	1	1	0	0	0	1	0	NA	1	?	1	1	1	0	9	Middle

Results

Appendix 1 shows the content of each study by purpose, general characteristics of the participants, measurements used for self-regulation, competitive level and academic performance, and the conclusion presented by the authors.

Self-regulation and competitive sport level

Metacognition

Five studies were found reporting that the use of self-regulatory skills favours athletes' achievement in sport. In general, elite youth athletes were found to be more self-directed and independent (Anshel, 1995; Anshel and Porter, 1996), and reported using self-regulatory skills more frequently (Jonker, Elferink-Gemser, Toering, Lyons, & Visscher, 2010b) than regional athletes or non-athletes.

Of the above-mentioned five studies, four studies emphasized the value of strategies that were considered to be related to reflective thinking, an individual's ability to apply prior experiences in order to improve subsequent performances in a goal-directed and effective manner (Mezirow, 1991; Peltier, Hay, & Drago, 2006; Zimmerman, 2000). Anshel and Porter (1996) showed an increased ability of elite swimmers to acknowledge their own strengths and weaknesses, when compared to non-elite athletes. Cleary and Zimmerman (2001) reported the better ability of basketball experts to recognize their strengths and weaknesses, when compared to non-experts and novices as well. However, they showed in addition that experts set more specific goals, selected more technique-oriented strategies, and modified their strategies based on causal attributions (classifying causes of success and failure;

27. Pajares & Valiante (2002)	1	1	1	1	1	0	0	1	0	NA	1	1	1	0	1	0	10	Middle
28. Pajares et al. (2000)	1	0	1	0	0	0	0	1	0	NA	1	?	1	1	0	0	6	Low
29. Pape & Wang (2003)	1	1	1	1	1	0	0	0	0	NA	1	?	1	1	1	0	9	Middle
30. Peters & Kitsantas (2010)	1	1	1	1	1	0	0	1	0	1	1	1	0	1	1	1	12	High
31. Roeschl-Heils et al. (2003)	1	0	1	1	1	1	0	1	0	NA	1	1	1	1	1	0	11	Middle
32. Rozencwajg (2003)	1	0	?	1	0	0	0	0	0	NA	1	?	0	1	0	0	4	Low
33. Sanz de Acedo Lizarraga et al. (2010a)	1	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	11	Middle
34. Sanz de Acedo Lizarraga et al. (2010b)	1	1	1	1	0	0	0	1	0	1	1	1	0	1	1	1	11	Middle
35. Schaefer & McDermott (1999)	0	1	1	1	1	0	0	0	0	NA	1	0	0	1	1	1	8	Middle
36. Schwinger et al. (2009)	1	1	1	0	0	0	0	1	0	NA	1	1	0	1	0	1	8	Middle
37. Thomas & McRobbie (2001)	0	1	1	0	0	0	1	0	0	1	0	?	0	1	0	0	5	Low
38. Toering et al. (2009)	1	1	1	1	1	0	1	1	0	NA	1	1	0	1	1	1	12	High
39. Usher & Pajares (2006)	1	1	1	1	1	0	0	1	1	NA	1	1	1	1	1	1	13	High
40. VanderStel & Veenman (2008)	1	1	1	0	1	0	1	1	0	NA	1	1	1	1	0	1	11	Middle
41. Veenman & Spaans (2005)	1	1	1	1	1	0	1	1	1	NA	1	1	0	1	1	1	13	High
42. Veenman et al. (2005)	1	1	1	0	0	0	1	1	1	NA	1	1	0	1	1	0	10	Middle
43. Watson & Lawson (1995)	1	1	1	1	0	0	0	1	1	1	1	?	0	1	1	0	16	High
44. Wolters (1999)	1	1	1	1	1	0	1	1	1	NA	1	1	1	1	1	1	14	High
45. Wolters & Rosenthal (2000)	1	1	1	1	1	0	1	1	0	NA	1	1	0	1	0	0	10	Middle
46. Zimmerman & Kitsantas (2005)	1	1	1	1	1	0	1	1	1	NA	1	1	0	1	1	1	13	High

Zimmerman, 2000). The ability of elite youth athletes to use past knowledge and experience to improve in the future is in line with a study by Toering and colleagues (2009). This study showed that when compared to non-elite soccer players, the elite youth soccer players were found to utilize reflection more frequently. Jonker and colleagues (2010a) even suggest that reflection can discriminate between athletes selected by The Netherlands Olympic Committee and Sports Federation (NOC*NSF) to compete internationally (best 1% of athletes within an age category) and those competing nationally (best 2.5%).

1 = Was the study purpose stated clearly?
2 = Was relevant background literature reviewed?
3 = Was the design appropriate for the study question?
4 = Were there any biases present?
5 = Was the sample described in detail?
6 = Was the sample justified?
7 = Was informed consent obtained? (if not described, assume no)
8 = Were the outcome measures reliable? (if not described, assume no)
9 = Were the outcome measures valid (if not described, assume no)
10 = Was the intervention described in detail?
11 = Were the results reported in terms of statistical significance?
12 = Were the analysis methods appropriate?
13 = Was clinical importance reported?
14 = Were the conclusions appropriate given the study methods?
15 = Are there any implications for clinical practice given the results of the study?
16 = Were limitations of the study acknowledged and described by the authors?

MQ: <.7.0 = low , ≥ 7 - ≤ 11 = middle, > 12 = high. Only studies with middle or high methodological quality were included in the results of this review.

Motivation
As well as an increased ability to reflect on prior actions to improve future performance, most studies reported that elite youth athletes are generally very motivated. Toering and colleagues (2009) showed that elite youth soccer players made more effort (willingness to invest) than non-elite soccer players. These results were extended by Jonker and colleagues (2010b) when elite youth soccer players were compared to a control population of mainstream Dutch students. The authors concluded that elite youth athletes may benefit more from training due to their increased ability to derive more from practice (reflection) and by trying harder to learn to become successful (effort). Anshel (1995) and Anshel and Porter (1996) showed that elite swimmers were indeed more committed to swimming and more serious about performing optimally as they were more willing to make an effort than their non-elite counterparts (commitment and execution). These two components accounted for correct group membership percentages of 73.2% for the elite swimmers and 60.0% for the non-elites (Anshel, 1995). Furthermore, elite athletes in swimming (Anshel, 1995) and basketball (Cleary & Zimmerman, 2001) were found to have higher levels of self-efficacy (belief in personal ability to execute the task successfully) than non-elite counterparts.

Self-regulation and academia

Metacognition
Eleven studies were found on the relationship between metacognition and academia. Four studies reported that students in general use metacognitive skills less frequently than expected by the researchers beforehand, both inside and outside school (Bergin, 1996; Lan, 2005; Meneghetti, De Beni, & Cornoldi, 2007; Veenman, Kok, & Blöte, 2005). However, good students distinguished themselves from poor students in terms of study skills (Meneghetti et al., 2007), reading strategies (Roeschl-Heils, Schneider, & van Kraayenoord, 2003), mathematics (Cleary & Chen, 2009; Miller, 2000), English (Miller, 2000), and overcoming constraints (Miller & Byrnes, 2001) on the basis of their use of metacognitive skills (Veenman et al., 2005; Wolters, 1999). Pape and Wang (2003) reported that high and low achieving students differ solely in the number of different strategies they use, but not in the total number of reported strategies (good and poor), confidence in their use of strategies or frequency of the use of strategies. Moreover, the use of metacognitive skills was found to predict students' academic results (Martín, Martínez-Arias, Marchesi, & Pérez, 2008; Miller & Byrnes, 2001; Nota, Soresi, & Zimmerman, 2004; Roeschl-Heils et al., 2003; Veenman & Spaans, 2005).

Furthermore, the relationship between metacognition, intellectual ability and academic achievement has been assessed by several researchers (Schaefer & McDermott, 1999; Schwinger, Steinmay, & Spinath, 2009; Veenman & Spaans, 2005; Veenman et al, 2005; Van der Stel & Veenman., 2008). Schaefer and McDermott (1999) showed that learning behaviour and intellectual ability contributed in complementary and interactive ways to students' scholastic achievement. These results were reproduced and extended by Veenman and Spaans (2005), Veenman and colleagues (2005), and Van der Stel and Veenman (2008), who showed that metacognition and intellectual ability both separately contribute to academic performance in which metacognitive skilfulness has a surplus value on top of intellectual ability. The relationship between intellectual ability and academic achievement was found by Schwinger and colleagues (2009) as well.

Other studies addressed their results to specific aspects of self-regulation. Jonker and colleagues (2010b) showed that students in the higher pre-university academic system reported more frequent use of self-monitoring (awareness of actions and progress during task execution) and evaluation (the ability to assess both the processes and the finished product after task completion) than students in the lower pre-vocational system. Lan (2005) took a more qualitative approach and revealed that successful students used their self-monitoring skills more often during exams and final quizzes when compared to general classroom situations. Strategies related to reflection were also found to be predictive for academic achievement. Nota, Soresi, and Zimmerman (2004) showed that students' academic performance could be predicted by their use of strategies referring to self-initiated overt and covert rearrangement of instructional material to improve learning. Strategies related to rewards and punishments were found to be predictive for enhancement of the motivation to proceed to further education, for example university. Martín and colleagues (2008) reported that specifically the factor 'strategic understanding', which is considered to be related to reflection, was most predictive for academic results. Students who scored high on this factor were better able to derive the main ideas from the information to be learned and are considered to know themselves well when it comes to how they approach learning.

Motivation
Five studies posited a relationship between students' levels of motivation (sometimes expressed as effort) and academic achievement. Wolters (1999) showed that students who regulate their motivation and work actively are more likely to be high academic achievers. This result has been reproduced for reading achievement by Roeschl-Heils and colleagues (2003). Schwinger and colleagues (2009) showed no direct relationship between motivation and academic achievement, but suggested that effort moderated this relationship and was predictive for GPA. Jonker and colleagues (2010b) also found that students in the higher pre-university system made more effort than students in the lower pre-vocational system. According to Cleary and Chen (2009), students become more motivated when they experience greater regulatory demands or course expectations. Wolters and Rosenthal (2000), on the other hand, did not find relationships between motivational beliefs (especially self-efficacy), the use of regulation strategies and math performance.

Six studies related self-efficacy perceptions to students' attained academic performance. The value of self-efficacy beliefs has been shown in writing (Pajares & Valiante, 1999), reading (Barkley, 2006; Usher & Pajares, 2006), language arts (Pajares & Valiante, 2002), school drop-out, grades (Caprara, Fida, Vecchione, Del Bove, Vecchia, Barbaranelli, & Bandura, 2009), academic choices, and general academic achievement (Usher & Pajares, 2006). These studies report that students' self-efficacy beliefs are predictive for their academic performance. Zimmerman and Kitsantas (2005) assessed whether homework practice was predictive for students' self-efficacy beliefs and thereby for their academic achievements. They showed

that homework practices have an effect on self-efficacy related to academic performance. However, learning ability and responsibility were mediational factors between homework practices and academic achievement.

Domain-general or domain-specific self-regulation and its development

Domain general or domain specific

There is much discussion about whether self-regulation should be considered as domain specific or domain general, and whether learners are able to make use of knowledge and skills obtained in one domain to progress in another. Three studies in the domain of sport and six in the academic domain were found to extend this discussion. For sports, Jones and Lavallee (2009) reported that British adolescents may profit from what are known as life skills (e.g., goal-setting and self-efficacy) obtained by being active in sports in everyday life. Jonker and colleagues (2010b) suggest a possibility of transfer between sport and academia as well. Their results showed no differences between elite youth soccer players in the higher pre-university system and those in the lower pre-vocational system, whereas these differences do exist in a mainstream population of Dutch students. Jonker et al. (2010b) found that the pre-vocational elite youth soccer players reported higher scores on effort and reflection than their pre-university mainstream peers. This may suggest, in line with Jones and Lavallee (2009), that elite youth athletes, irrespective of academic level, may profit from being active in sports at a high competitive level. On the other hand, Anshel and Porter (1996) showed that swimmers were not able to use their psychological characteristics outside their sport as the included generalization component of self-regulation was not supported.

In academia, suggestions for the near-far possibility of transfer (Brainerd, 1975) have been reported by Sanz de Acedo Lizarraga and colleagues (2010b), as the authors observed that students who were taught
according to their 'think actively in academic contexts (TAAC)' method were able to use their learning strategies in other classes than those in which they learned these strategies. Similar results were produced in a population of 16-to-18-year-old students who received the TAAC. These students were also able to transfer their learned skills between classes (Sanz de Acedo Lizarraga, Sanz de Acedo Baquedano, & Oliver 2010a). The possibility for near-far transfer was also underlined by the results of Miller (2000) and Ben-David and Zohar (2007). These studies showed a strong positive association between the two content domains mathematics and English in secondary school students (Miller, 2000), and in the results of a delayed transfer test, which assessed retention of what has been learned by students who received an intervention focusing on metacognitive skill use (Ben-David & Zohar, 2007). These results suggest that a higher-order self-regulated learning factor cannot be ruled out. The results from Moore and Scevak (1995), on the other hand, revealed no effects of training on transfer from learning from science textbook to other academic domains.

According to Van der Stel and Veenman (2008) and Veenman and Spaans (2005), the possibility of students using their self-regulatory skills in a domain-general way is related to age. The authors reported that self-regulatory skills initially develop as domain-specific skills, but that students from approximately 12 years of age become more able to

apply these skills between learning domains. This suggestion was based on their findings that the metacognitive skills of 12-year-olds seem to possess both a domain-specific and a domain-general component (Van der Stel & Veenman, 2008). However, the self-regulatory skills of first-year secondary school students (12-to-13-year-olds) were mainly domain specific, whereas third-year students (15- to 16-year-olds) displayed more domain-general metacognitive skills. Twelve-year-olds were suggested to be in a transition phase after which their metacognitive skills gradually merge into a set of domain-general skills (Van der Stel & Veenman, 2008).

Development of self-regulation

Six studies assessed the development of self-regulatory skills in youth. As reported above, most studies showed in cross-sectional research designs that students later in adolescence are generally more able to use self-regulation than students early in adolescence (Martín et al., 2008), specifically when it comes to domain-general self-regulation (Van der Stel & Veenman, 2006; Veenman & Spaans, 2005). Similar findings were reported by Lan (2005), showing that older students reported self-monitoring more frequently during learning than their younger peers. Nevertheless, results are not uniform as Roeschl-Heils and colleagues (2003) showed stability in students' use of metacognitive skills in years one and two of secondary school (12-14 years of age). Cleary & Chen (2009) even reported a decline in students' use of metacognitive skills at the beginning of the middle school years. A decline in students' self-efficacy from junior to senior secondary school was also reported by Caprara and colleagues (2008) using a longitudinal design.

Metacognitive and motivational teaching in academia

Intervention studies

Although relatively few studies (n = 6) examined the development of self-regulatory skills in youth, most studies assume that the use of these skills can be learned and prompted. Schaefer and McDermott (1999) showed that students trained to use optimum levels of self-regulatory behaviour will have a distinct advantage over those without training within a population of students with roughly comparable levels of academic ability. Veenman and colleagues (2005) showed that providing students with metacognitive cues (reminding students to use the metacognitive skills in their repertoire) triggered students' use of metacognitive activities. Bergin (1996) suggests that teachers should motivate students in such a way that students become so interested in the topic that they are willing to apply their self-regulatory skills, and Eshel and Kohavi (2003) emphasize the importance of balancing student and teacher control in class. Students used their self-regulatory skills most when student control was high and teacher control was low.

Several other studies assessed how to stimulate students to use self-regulation in intervention studies. Peters and Kitsantas' (2010) intervention focused on metacognitive prompting (MPI-S) and showed that students in the intervention groups had increased content knowledge and nature of science knowledge when compared to the control group. In addition, the intervention group had a more sophisticated form of self-regulation. These students reported that they no longer studied for exams by learning off by heart, but were able to recognize the interconnectedness of their study material and dis-

played more confidence in redoing activities. Similar results were obtained from the Self-Regulation Empowerment Program (SREP), which focused on improving self-regulation, motivation and test performance by focusing students' attention on Zimmerman's three-phase self-regulation model. Results of this intervention showed that the five students who received the SREP intervention displayed higher levels of self-regulation and motivation (Cleary, Platten, & Nelson, 2008).

The results of Sanz de Acedo Lizarraga and colleagues' (2010a, 2010b) TAAC also underline the effectiveness of this intervention for students' use of self-regulation and academic performance. The interventions developed by Moore and Scevak (1995) and Ben-David and Zohar (2007) produced similar results. Their interventions focused on instructing students to use metacognitive knowledge and strategies in science-related educational contexts. Students in the experimental group were able to use what they were taught in the area of learning science after a 7-week intervention (Moore & Scevak, 1995), and the effects on scientific enquiry learning even remained after three months (delayed transfer test; Ben-David & Zohar, 2007). Furthermore, the latter study showed that the low achieving students' academic performance increased dramatically through the explicit teaching of metacognitive skills and was usually higher than that of the high achieving control group.

Mevarech and Kramarski (2003) compared the effects of two types of stimulation to use self-regulation, namely metacognitive training versus worked-out examples (a demonstration of the problem-solving process). Results showed that students who received the metacognitive training intervention outperformed students who received the intervention based on worked-out examples. Watson and Lawson (1995) designed an intervention that focused on disposition, problem analysis and representation, memory search and management of activity. Students were randomly assigned to an experimental, a partially experimental or a control group. Their results showed an improvement in the performance of the experimental group between test 1 and test 2 of which 22.6% could be attributed to the treatment variable. This difference remained between test 2 and test 3 with 15.5% of the variance attributable to the treatment variable.

Other factors: type of sport, gender and socioeconomic status

Several studies reported other factors that may influence self-regulation, such as the type of sport athletes participate in (team sports or individual sports), gender and socioeconomic status. Jonker and colleagues (2010a) assessed the role of six self-regulatory skills in elite youth athletes identified as junior internationals or junior nationals in five team sports and five individual sports. Their results showed that athletes who took part in individual sports outperformed their peers playing team sports on planning (awareness of the demands of a task prior to its execution) and effort (willingness to invest), and that these results became more evident in higher competitive levels. The researchers suggest that these differences may be related to the more static character in which individual types of sport are performed, which suits those aspects of self-regulation better. With regard to differences between boys and girls, relatively minimal gender differences in self-regulation were observed in a population of elite athletes (Anshel & Porter, 1996), while most studies in the educational setting

reported girls to be generally more self-regulative than boys (Cleary & Chen, 2009; Martín et al., 2008). In addition, Martín and colleagues (2008) showed that students high in socioeconomic status report using self-regulatory skills more frequently than students low in socioeconomic status.

Discussion

The purpose of this study was to give a systematic overview of self-regulatory literature in the domains of sport and academia in youth between 12 and 18 years of age. Based on this overview, we wanted to examine whether self-regulatory skills can serve as an underlying characteristic of good performance in sport and academia, and whether there are differences in self-regulatory skills that contribute the most to performance in sports or in academia.

In line with the 1986 discussion that came to a uniform definition of self-regulation (see introduction), our results showed several variations in concept, definition and measurement between studies, even within the domains of sport or academia. Nevertheless, all concepts and definitions seemed to be based on the more general assumption that in order to improve and regulate learning behaviour, learners must be able to set specific and personal attainment goals that are based on prior experiences. Based on these attainment goals, learners make a planning beforehand, monitor their progress during performance, and evaluate the end product and learning process afterwards in order to set new attainment goals (e.g., Cleary & Chen, 2009; Toering et al., 2009; Wolters, 1999). Furthermore, motivational characteristics such as effort and self-efficacy were frequently mentioned as important as youth must be willing to make an effort to improve and must believe in their ability to reach their goals (e.g., Cleary & Chen, 2009; Toering et al., 2009; Wolters, 1999). These findings are, therefore, in general agreement with Zimmerman's (1986, 2000, 2006) theory of self-regulation that learners must be metacognitively, motivationally and behaviourally proactive participants in their own learning process in which three cyclical phases are involved. The beneficial effects of using self-regulatory skills have been separately reported by several studies in sports (e.g., Anshel, 1995; Anshel & Porter, 1996; Jonker et al., 2010a, 2010b; Toering et al., 2009) and academia (e.g., Miller, 2000; Miller & Byrnes, 2001; Roeschl-Heils et al., 2003; Veenman & Spaans, 2005; Veenman et al., 2005), favouring those who were found to use their self-regulatory skills more frequently (e.g., Jonker et al., 2010a, 2010b; Toering et al., 2009) and better (e.g., Anshel, 1995; Anshel & Porter, 1996; Cleary & Zimmerman, 2001; Lan, 2005; Pape & Wang, 2003; Zimmerman & Kitsantas, 2005).

With regard to our aim to examine whether a general set of self-regulatory skills may be useful between the domains of sport and academia, recent studies in the academic setting support the possibility for transfer of self-regulatory skills between academic tasks (Sanz de Acedo Lizarraga et al., 2010a, 2010b; Ben-David & Zohar, 2007; Miller, 2010). For example, Miller (2010) showed a strong positive correlation between students' use of self-regulatory skills and the content domains of English and mathematics. Although relevant, this does not tell us much about the possibility for the transfer of self-regulatory skills

between different performance domains such as sport and academia. In this perspective, the self-regulated learning theory of Zimmerman (1986, 2000) has been applied within sports and academia separately (e.g., Cleary & Zimmerman, 2001 in sports and Cleary et al., 2008; Nota et al., 2004; Zimmerman & Kitsantas, 2005 in academia). Based on this theory, Jonker and colleagues (2010b) showed that elite youth soccer players displayed higher levels of self-regulation than their mainstream peers and were significantly more often present in the higher pre-university system. Although not empirically determined, Jones and Lavellee (2009) suggest that British adolescents may have benefited from self-regulatory skills developed by being active in sports in everyday life. Although these studies suggest the possibility for successful transfer between sport and academia, no studies were found that actually assessed this topic.

Veenman and Spaans (2005) and Van der Stel and Veenman (2008) did not examine the direct possibilities for transfer of self-regulatory skills between domains; rather they examined the domain-general or domain-specific nature of self-regulatory skills in youth. According to these authors, the possibility for students to use their self-regulatory skills in a domain-general way is related to age. Their results showed that children start to develop self-regulatory skills initially as domain-specific skills from an early age, but are assumed to be able to use these skills consciously and in a domain-general way from approximately 12 years of age.

Neurodevelopmental research confirms that executive functions (psychological processes such as self-regulation that are involved in the conscious control of thought and action) develop from an early age as well. In addition, children are approximately 12 years of age when able to use them (Zelazo & Müller, 2002). In this perspective, age as a developmental factor seems an important aspect in the use of self-regulatory skills. Nevertheless, only six studies were found that assessed the development of self-regulatory skills in 12-to-18-year-old youth. Five of them assessed self-regulation using cross-sectional research designs and therefore could only base their conclusions on differences between older and younger subgroups. We recommend that future research examines the development of self-regulatory skills longitudinally. Results from these studies may reveal how students or athletes develop self-regulatory skills and which stimuli contribute to this development.

This might be interesting in the context of intervention studies as well. As several studies have reported the relatively minor use of self-regulatory skills in academic contexts (Bergin, 1996; Lan, 2005; Meneghetti et al., 2007; Veenman et al., 2005), teaching students use effective methods has become a hot topic of research, particularly in the last decade. The effects of these recent intervention studies in the academic setting showed that students can be cued and prompted to use their self-regulatory skills (Ben-David & Zohar, 2007; Moore & Scevak, 1995; Sanz de Acedo Lizarraga, 2010a, 2010b). For example, Cleary and colleagues (2008) showed that focusing students' attention on using self-regulatory skills indeed resulted in increased levels of self-regulation and motivation. These results were extended by Peters and Kitsantas (2010). Their students reported that after receiving the intervention, they no longer studied for exams by learning off by heart, but that they had become able to recognize the interconnectedness of their study material. Another interesting finding was reported by Ben-David and Zohar (2007), who found that the academic performance of low achieving students in particular increased through the explicit teaching of self-regulatory skills to the extent that their self-regulatory scores were usually higher than those of the high achieving control group. Results from these studies suggest that the educational system can stimulate the ability of students to self-regulate their learning process and their performance related to their achievement goals.

Even though these intervention studies seem to be effective in the academic setting, based on the assumption that people are best able to develop self-regulatory skills in an inspiring environment in which the aspects of goal-setting and feedback play a role (Boekaerts, 1997; Boekaerts & Corno, 2005), the sports environment may be even more suitable for the acquisition of self-regulatory skills. This environment enables athletes to relatively easy set specific short- and long-term goals, and they receive constant feedback about the action itself in terms of the performance process and the result achieved from trainers, parents and other participants (Jonker et al., 2010b). This may be most strongly related to elite sports as higher competitive levels are characterized by higher numbers of hours of training, in which the level of goal-setting is assumed to be more challenging and the feedback received more specific. However, athletes in mainstream organized sport settings are also forced to set personal goals for improvement and continually receive feedback. This means that they can profit from and be coached to develop and use their self-regulatory skills within and between performance domains. Unfortunately, no intervention studies conducted in the sport domain were found.

The above-mentioned assumptions are based on the information that self-regulatory skills can be used as domain-general skills (e.g., Eccles & Feltovich, 2008) within and between performance domains. Studies conducted by Van der Stel and Veenman (2008) and Veenman and Spaans (2005) show that students should be able to utilize their self-regulatory skills later in adolescence in particular. This may indicate that youth in secondary education in particular must be cued to use their self-regulatory skills in the learning situations in which they are involved. To assess this possibility for the transfer of self-regulatory skills between domains, we still have to solve a measurement issue. Our results show that different measurement instruments, such as self-report, think-aloud protocols and interviews, are used and that most are domain specific in nature. We assume that only when measurements can be utilized between performance domains the results of intervention studies can be compared and contribute to the possibility for successful transfer between domains. More practically, after intervention studies and by assessing students' or athletes' self-regulatory skill use, their use of these skills should be measured not only in the domain in which the intervention took place, but also in the domain for transfer by using the same measurement. Only studies conducted by Jonker and colleagues (2010a, 2010b) and by Toering and colleagues (2009) used a general self-regulatory instrument and used it between performance domains.

In addition to this measurement issue, other measurement concerns are related to the question of whether people are able to report their self-reported cognitions properly and without being susceptible to giving socially desirable answers, which needs to

be the case when using self-report questionnaires, interviews and think-aloud protocols (Eccles, in press; Young & Starkes, 2006). We therefore recommend that future studies develop instruments that can be applied within and between performance domains to make the results achieved comparable, and to relate results obtained by self-report instruments to observed behaviour within a specific domain. Results obtained by these methods may further reveal the beneficial effects of intervention studies on youth's use of self-regulatory skills and the possibilities for successful transfer.

With regard to the last aim of this study, namely whether there are differences in the self-regulatory skills that contribute most to performance in sports or academia, research in the educational setting showed that students' use of self-regulatory skills is predictive for academic results (e.g., Martín et al., 2008; Miller & Byrnes, 2001; Nota et al., 2004; Roeschl-Heils et al., 2003; Veenman & Spaans, 2005). Specifically the use of self-monitoring (Jonker et al., 2010b; Lan, 2005) and reflection (Martín et al., 2008; Nota et al., 2004) were related to increased academic performance. Students who reported using self-monitoring and reflection more frequently appeared to be more aware of whether they were still on track during task execution (Lan, 2005), and were better able to rearrange their actions related to their personal achievement goals and to distil the main ideas from the information to be learned (Martín et al., 2008; Nota et al., 2004). In sports, skills related to reflection (Anshel & Porter, 1996; Cleary & Zimmerman, 2001; Jonker et al., 2010b; Toering et al., 2009), effort (Jonker et al., 2010b; Toering et al., 2009), commitment (Anshel, 1995; Anshel & Porter, 1996), and self-efficacy (Anshel, 1995; Cleary & Zimmerman, 2011) have been reported to distinguish best between athletes of different competitive level. It is suggested that elite athletes benefit more from training and practice through the ability to use past experience to improve future performance, and they are also more committed to their goals (Anshel, 1995; Anshel & Porter, 1996; Jonker et al., 2010a; Toering et al., 2009). In addition, they displayed higher self-efficacy belief (Anshel, 1995; Cleary & Zimmerman, 2001). Nevertheless, no studies were found that tried to predict whether an increased use of these specific self-regulatory skills would lead to increased performance in sports, although this seems especially interesting from a talent development perspective. To elaborate, the main question in talent development research is who is going to make it to the top and who is not, and, moreover, which characteristics may determine future success in sports. We assume that coaches will be at least curious to know what their athletes' levels of self-regulation are as these aspects may be related to learning potential over the years. We therefore advise that the predictive value of self-regulatory skills for sport performance be assessed in future research.

In conclusion

The use of self-regulatory skills is found to be beneficial for sport (e.g., Anshel, 1995; Anshel & Porter, 1996; Jonker et al., 2010a, 2010b; Toering et al., 2009) and academic (e.g., Cleary & Chen, 2009; Miller, 2000; Miller & Byrnes, 2001; Roeschl-Heils et al., 2003; Veenman & Spaans, 2005; Veenman et al., 2005; Wolters, 1999) performance in 12-to-18-year-old youth. Although the exact development of self-regulatory skills at secondary school age remains unclear, some studies suggest that youth, specifically when they have reached the age of 12, may be able to apply their self-regulatory skills between performance domains (Jones & Lavallee, 2009; Jonker et all, 2010b; Van der Stel & Veenman, 2008; Veenman & Spaans, 2005), for example in sports and at school. This has several interesting implications for future research, namely to assess how self-regulatory skills develop in a secondary school-age population related to their sport and academic characteristics, whether the sport context may be highly suitable for the development of self-regulatory skills, and whether elite youth athletes' use of self-regulatory skills may be predictive for athletic performance in the future.

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Appendix 1. Results of the studies examining variables associated with aspects of self-regulation, measures of competitive sport level and measures of academic achievement.

	Authors	Purpose/Research Questions	Participants					Measurement			Results/Conclusions
			N	Age (years)				Name			
				M	*SD*	Range			Items	Type	
1.	Anshel (1995)	To examine differences in the use of self-regulation in elite and non-elite competitive male swimmers.	125	19.4	NA	17-22	SR SP	NA[ED] Competitive level	100 -	5p. LTS -	Elite swimmers are more self-directed, independent, serious and make more effort to achieve swimming success and had more self-confidence.
2.	Anshel & Porter (1996)	To assess SR in elite and non-elite, male and female swimmers.	270 79 67 57 67	 20.7 20.3 17.8 17.5	 NA NA NA NA	11-44 NA NA NA NA	SR SP	NA[ED] Elite vs non-elite	100	5p. LTS	Elite swimmers were more self-directed, independent, committed, serious, capable of acknowledging their strengths and weaknesses and make more effort. Minimal gender differences were observed.
3.	Barkley (2006)	To examine the relationship between student and teacher self-efficacy beliefs and self-efficacy can predict reading comprehension.	400 42	NA NA	NA NA	NA NA	SR SR AP	Self-efficacy[ED] Self-monitoring[ED] SAT	NA NA NA	4p. LTS 4p. LTS NA	Similarities and differences between students' and teachers' self-efficacy are observed, as well as significant correlations between self-efficacy and reading comprehension.
4.	Ben-David & Zohar (2009)	To assess the instructional effects of meta-strategic knowledge on scientific thinking strategies, whether differences exist between low and high achieving students and the possibility of transfer.	119	NA	NA	13-14	AP AP SR	Mean academic score Sci. inq. learn. Task Written test (pre, post, delayed)	11 NA -	Grades NA 0-6	Explicit teaching of MSK was effective especially in the low achieving group. When compared to the control population, the experimental population had higher scores on the delayed transfer test.
5.	Bergin (1996)	To assess the use of self-regulation in out-of-school learning settings.	210	NA	NA	NA	AP SR SR	Grades Self-efficacy Learning strat.[ED]	- 13 19	11p. s. 0-10 s. Yes - no	Students' rate of strategy use in out-of-school learning settings is low. Students with higher interest report greater use of SR.
6.	Caprara (2008)	To examine the development of perceived self-efficacy for self-regulated learning and its contribution to academic achievement and remaining in school in students.	412	NA	NA	12-22	SR AP AP AP	Self-efficacy Grades Examination Graduation grade	11 NA NA NA	5p. LTS 60-100 NA 0 or 1	Students decline in self-efficacy when they advance through the educational system. Students with a lower decline in self-efficacy have higher grades and a greater likelihood of remaining in school.
7.	Cleary & Chen (2009)	To assess differences in students' self-regulation strategies and motivational beliefs across grade level, gender, and maths course type, and which variables most strongly predicted students' strategy use.	880	NA	NA	NA	SR SR SR SR AP	SRSI-SR TTI PII Self-standards[ED] Outcome of intervention	20 4 4 1	5p. LTS 5p. LTS 5p. LTS 1-13	Use of SR and motivation vary across grade level and maths course type and importance of the use of these strategies increased when students experienced greater regulatory demands or course expectations.

8.	Cleary & Zimmerman (2001)	To assess differences in self-regulation between experts, non-experts and novices during basketball free-throw shooting.	43	NA	NA	15.5-16.5	SR SR SR SR SP	Self-efficacy [ED] Goal-setting[ED] Strategy choice[ED] Attributions[ED] Shooting skill	NA 1 2 NA	0-100s Open end 0 or 1 Open end	Experts show higher quality self-regulatory skills during self-directed practice than non-experts or novices.
9.	Cleary et al. (2008)	To assess the effectiveness of the SREP intervention to improve self-regulation, motivation, and test performance in high school students.	7	NA	NA	NA	AP AP SR SR SR SR SR	Biology test score WKCE SRSI-SR RSSRL Self-efficacy PALS SRC field notes	NA NA NA 28 9 10 6 NA	MC Open end NA 5p. LTS 5p. LTS 11p. LTS 11p. LTS NA	Students who received the intervention improved from their baseline score to intervention and displayed higher levels of self-regulation and motivation, and higher self-confidence. This was not observed in the comparison group.
10.	Eshel & Kohavi (2003)	To examine the relationship between teacher control styles in classroom settings and students' self-regulated learning and academic achievement.	302	NA	NA	12-13	SR SR SR SR AP	Cogn. Stat. scale MSE SE-SRL SE-AD Math. test	13 9 11 7 54	NA NA NA 7p. LTS NA	Students' use of SR is highest when they are in control of their own learning and their academic performance is highest with combined teacher and student control. Control should be balanced to develop independent learners, capable of goal-setting and using SR.
11.	Jones & Lavallee (2009)	To gain an understanding of life skills needed for adolescents between 15 and 22 years of age.	649 15.6 NA	17.2 15.6 NA	0.6 0.5 NA	16-18 15-17 15-22	SR SP	Interview[ED] Interview[ED]	NA NA	Open end Closed	Life skills are domain-general skills needed for everyday life and can be categorized as personal and interpersonal skills. Future interventions should focus on adolescents' self-awareness by means of reflection.
12.	Jonker et al. (2010a)	To assess possible differences in self-regulatory skills within a group of highly talented athletes (junior internationals or junior nationals) competing in team or individual sports.	222 47 66 31 78	NA 14.3 14.0 14.8 14.1	NA 1.1 1.1 1.1 1.0	12-16	SR SR SR SP SP	Self-report[ED] Self-report[ED] Self-report[ED] Jun. international Jun. national	NA 5 8 NA NA	4p. LTS 5p. LTS 5p. LTS	Talented athletes in individual sports outscored talented athletes playing team sports on planning and effort. The junior internationals had higher scores on reflection than the junior nationals.
13.	Jonker et al. (2010b)	To determine whether elite youth soccer players achieved relatively better academic standards than controls and the possible role of self-regulatory skills in sport and academic performance.	292 128 164	 13.9 14.2	 1.3 1.3	12-16	SR SR SR SP AP	Self-report[ED] Self-report[ED] Self-report[ED] Competitive level Academic level	NA 5 8 NA School	4p. LTS 5p. LTS 5p. LTS	Elite youth soccer players are more often enrolled in the higher pre-university academic system than controls and displayed an increased use of self-regulatory skills.
14.	Lan (2005)	To investigate the self-monitoring strategies in students at different educational levels in learning situations with different levels of task importance.	510	NA	NA	NA	SR AP	Self-report[ED] Educational level	3 NA	Open-end NA	Six self-monitoring skills were identified, but students used them less frequently than expected. Older students displayed more frequent use than younger students. The use of self-monitoring increased with task importance.

15.	Martín et al. (2008)	To assess personal and institutional variables that can predict academic achievement in students longitudinally.	965	15.8	0.8	15-18	SR SR AP	CEAM Learning strat. Motivation Metacognition Specific tests	 10 10 25 30	 NA NA NA MC	Learning strategies and metacognitive abilities are strong personal predictors for students' academic success.
16.	Meneghetti et al. (2007)	To assess the knowledge of, the use of and consistency in the use of efficacy strategies in students with good and poor study skills.	354	NA	NA	12-15	SR AP AP	AMOS Teacher ratings AMOS study task	32 38 8 6 15	4p LTS - MC Open True/false	Students with poor study skills were less able to make the distinction between good and poor study skills and were less consistent in matching their knowledge to their use of strategies.
17.	Mevarech & Kramarski (2003)	To assess the effects of metacognitive training vs worked-out examples in students' mathematics performance and the long-term effects of the interventions.	122 122?	14.2 15.4	0.6 0.3	NA NA	AP AP SR	Pre-test: Algebra Post-test: time-distance-speed Videotape	32 8 -	0-32 0-12 1-5	Students in the metacognitive training group outscored students in the worked-out examples group not only immediately after the intervention, but also in the delayed post-test.
18.	Miller (2000)	To examine ways in which to become a self-regulated learner and whether self-regulation is domain specific.	297	NA	NA	NA	SR AP AP AP	MSPSE (SRL) Mathematics English ACT assessment	11 NA NA 44	s 7p. LTS 7p. LTS NA	Students use external comparisons to develop self-regulation. Existence of higher order, domain-general self-regulation is suggested.
19.	Miller & Byrnes (2001)	To assess adolescents' use of SR in decision-making and whether this is predictive for academic choices.	412	NA	NA	NA	SR SR AP	LASSI-HS Developed GPA	23 30 -	5p. LTS - -	SR competences in decision-making were the best predictors of AP.
20.	Moore & Scevak (1995)	To examine the effects of a 7-week strategy training intervention, taking reading ability into account.	41	NA	NA	14-15	AP SR	Text test - SLIC strategies	8 -	MC Free recalls	The intervention is useful as participants were able to use what they had been taught. No effects of training on transfer were observed.
21.	Nota et al. (2004)	To examine the relationship between secondary school students' use of SR and their subsequent academic achievement and resilience.	81 49	17.1 NA	0.2 NA	NA NA	AP AP SR	Grades Willingness to further education SRLIS	- - -	10p.s 11p LTS Interview	Strategy use to improve learning was predictive for AP, but not for students' choice to further education. Rewards and punishments regarding possible life paths were predictive in this sense.
22.	Pajares & Valiante (1999)	To examine students' writing self-efficacy and whether there are differences related to grade level and gender.	742	NA	NA	NA	SR SR SR SR SR SR AP	WSES Ability comparison ASDQ-1 Writing apprehension SAQ CMSES Teacher ratings	10 NA 6 4 2 7 NA	0-100 6p. LTS 6p. LTS NA 6p. LTS 6p. LTS NA	Self-efficacy was predictive for writing competence. Students in lower grade levels reported higher self-efficacy for self-regulation than students in higher grade levels. Girls and boys did not differ in their writing self-efficacy.
23.	Pajares & Valiante (2002)	To assess the development of students' confidence in SR strategies and the relationship between self-efficacy for SR in language arts.	1257	NA	NA	9-17	SR SR AP	CMSES SE language arts Teacher ratings	7 5 NA	6p. LTS 1-6 5p. s	Students' self-efficacy beliefs for self-regulation decrease as students progressed from primary to secondary school. Gender differences are a result of gender-stereotypical beliefs.

24.	Pape & Wang (2003)	To assess the relationship between the use of self-regulation and academic achievement, problem-solving behaviours, and problem-solving success.	80	11.9	0.7	NA	SR AP	SQ Maths word problem	- NA	- NA	High achieving students reported a broader scale of strategies then low achieving students, but did not differ in the total number of reported strategies and their using confidence and frequency.
25.	Peters & Kitsantas (2010)	To examine the effectiveness of metacognitive prompts for students.	162	NA	NA	13-14	AP AP AP SR SR SR	TEMK VNOS-B Evaluation of product Teacher memos Think-aloud protocols Post-test interviews	19 7 2 NA - 12	Open-end Open-end Teacher NA - Open-end	Students exposed to metacognitive prompts had increased content knowledge and nature of science knowledge and a more sophisticated form of self-regulation.
26.	Roeschl-Heils et al. (2003)	To examine the relationship between reading performance, metacognition and motivation in 'good' and 'poor' readers.	59	NA	NA	NA	AP AP SR SR SR	ADST Two texts BB KANUCOMP KANUSTRAT MSTRAT WMMT	Text Gaps 12 12 5 18	0-10 p. 0-7 6p. LTS 6p. LTS NA 0-36	Students with better metacognitive knowledge and motivation are better readers. Metacognition is the best predictor for reading ability and is stable over time.
27.	Sanz de Acedo Lizarraga et al. (2010a)	To examine the effects of the TAAC in adolescents between 16 and 18 years of age and the effect on academic achievement.	46	17.0	0.9	16-18	SR SR SR SR AP AP AP	CIT, scale 3 EFAI - Verbal reasoning - Abstract reasoning - Numerical reasoning CREA ACRA AAT	46 26 24 27 NA 35 60	NA NA NA NA NA 5p. LTS NA	Effects of the TAAC were obtained for the aspects of cognitive resources of metacognition, self-regulation and transfer and in relation to improved academic performance. The educational system can stimulate the ability of secondary school students to think better, which improves academic performance.
28.	Sanz de Acedo Lizarraga et al. (2010b)	To assess the results of the TAAC, a method of thinking skills, self-regulation and academic learning in secondary education and the possibilities of transfer of the training.	110	13.1	0.6	NA	SR SR SR SR SR SR AP AP AP	CIT, scale 2 DAT-5, level 1 - Verbal reasoning - Abstract reasoning - Deductive reasoning - Inductive reasoning CREA ACRA AAT	46 40 40 23 50 NA 35 60	NA NA NA NA NA NA 5p. LTS NA	The TAAC stimulates cognitive functioning and self-regulation in second-grade students and transfer effects were obtained. In addition, the intervention resulted in better academic performances through the use of learning strategies. The authors suggest that self-regulation is not learned unless the school emphasizes its importance.
29.	Schaefer & McDermott (1999)	To assess the use of strategies and intelligence in children's academic performance.	1.100 420	NA NA	NA NA	6-17 6-17	SR AP	LBS Grades	29	3p. LTS 50-100s	Strategy use and intelligence contribute in complementary and interactive ways to children's scholastic achievement.
30.	Schwinger et al. (2009)	To assess the role of motivation and intelligence as moderators in the relationship between motivational regulation strategies and achievement in German students.	231	16.8	0.8	16-19	SR SR AP AP	MRQ MSLQ (effort) GPA Intelligence test: CFT 3	30 8 - NA	5p. LTS 5p. LTS 1-6 NA	Most of the motivational regulation strategies were not directly related to GPA but correlated with effort management, which was directly related to GPA. Intellectual ability moderates the effects of motivational regulation on effort exertion and achievement.

31.	Toering et al. (2009)	To examine the relationship between self-regulation and performance level in 11-to 17-year-old youth soccer players at two different competitive levels.	444	14.4	1.4	11-17	SR SR SR SR SR SR SP	Planning Self-monitoring Effort Self-efficacy Evaluation Reflection Competitive level	9 7 9 12 8 5 -	4p. LTS 4p. LTS 4p. LTS 4p. LTS 5p. LTS 5p. LTS -	The elite youth soccer players reported using reflective skills more frequently and indications are that they make more effort to execute their tasks successfully. Self-regulation may be an important characteristic in the development of youth soccer players.
32.	Usher & Pajares (2006)	To examine the influence of self-efficacy on academic (CMSS-AP) and SR efficacy beliefs (CMSS-SR), taking into account gender, reading ability and ethnicity.	263	NA	NA	10-13	SR SR SR AP AP	SSES CMSS-AP CMSS-SR Competence test Teacher recommendation	24 6 - - -	- 6p. LTS - - -	The beliefs students hold about their academic abilities and about their SR influence their academic choices and AP. This is not uniform for gender, reading ability and ethnicity.
33.	Van der Stel & Veenman (2008)	To examine the relationship between intellectual ability and metacognitive skilfulness in young students and whether these metacognitive skills are domain specific or domain general.	32	12.7	NA	NA	AP AP AP AP SR	GIVO Memory test Study task history Maths prob. solving Think aloud	NA NA NA 2x5 4	NA NA NA NA 0-4	Both metacognitive skilfulness and intellectual ability make their own unique contribution to learning performance. The metacognitive skills of 12-year olds were both specific and domain general. 12-year-olds are in a transitional phase during which their metacognitive skills merge into a set of domain-general skills.
34.	Veenman & Spaans (2005)	To assess the relationship between intellectual ability and metacognitive skills, their development into either domain-specific or domain-general skills, and their stability over time.	32 16 16	12.6 15.3	1.0 0.5	NA NA	AP AP AP AP AP SR SR	GIT Maths word problems Biology task ML IL Observations Log files from PC	3 NA NA NA 27 14 -	NA NA NA 0 or 1 NA 0-2 -	Metacognitive skills had a surplus value on top of intellectual ability and predicted learning performance. Metacognitive skills developed alongside intellectual ability and increased with age. Older students had more domain-general metacognitive skills.
35.	Veenman et al. (2005)	To examine the mixed model of self-regulation in 12-to-13-year-old children and whether metacognitive cues have an impact on children's use of metacognitive skills.	41	NA	NA	12-13	AP AP SR	Problem-solving[ED] GPA Observation (SO)	6 0 15	0 or 1 0-10 NA	Metacognitive skills have their own virtue in learning, partly independent of intellectual ability (i.e., mixed model). Metacognitive cueing resulted in better learning outcomes. Educators should provide students with metacognitive cues. Intellectual skills come in afterwards.
36.	Watson & Lawson (1995)	To examine the use of strategy training for question answering in geography.	55	NA	NA	NA	AP SR	NA[ED] Intervention	32 -	NA -	The group that received the strategy training improved significantly within the first week of training (between t1 and t2). This difference remained between t2 and t3.
37.	Wolters (1999)	To assess the relationship between five motivational regulation strategies and the use of metacognitive skills, effort and academic achievement in students.	88	15.1	0.7	14-16	SR SR SR AP	6 SR scales[ED] Effort Mot. Regulation GPA	130 8 NA -	NA NA 1-7 0-6	Students who use motivational regulation strategies, metacognitive skills and make more effort in their academic tasks tend to be high academic achievers.

38.	Wolters & Rosenthal (2000)	Explored the relationship between students' motivational beliefs and use of SR.	114	13.8	0.4	13-15	AP SR SE	Match test score SR[ED] PALS	60 26 4	MC 7p. LTS 7p. LTS	Motivational beliefs were predictive for students' use of SR except self-efficacy. No conclusions were drawn regarding maths performance.
39.	Zimmerman & Kitsantas (2005)	To assess the role of homework practices on self-efficacy beliefs and academic achievement.	179	16	NA	14-19	AP AP AP SR SR	NEDT scores GPA Homework scale Quantity Quality Self-efficacy[ED] Responsibility[ED]	NA NA 2 5 57 18	NA NA Open end Yes or no 0-100 7p. LTS	Girls' homework practices predicted their perceived self-efficacy for learning ability and responsibility. Learning ability and responsibility were subsequently predictive for their academic achievement.

Note.
NA = Not available,
AP = academic performance,
SP = sport performance,
SR = measure of self-regulation,
MC = multiple choice,
LTS = Likert-type scale,
ED = Especially designed for the study,
s = scale,
p = point.

Chapter 3

Talented athletes and academic achievements: A comparison over 14 years

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Abstract

The purpose of this study was to gain insight into the academic achievements of 200 talented athletes in 1992/1993 and 200 in 2006/2007, aged 14–16 years. When compared with the national average, the athletes in 2006/2007 attended pre-university classes more often (χ^2 = 57.001, p<.05). Of the 2006/2007 athletes, a higher percentage participated in pre-university programs compared with that of athletes in 1992/1993 (χ^2 (1, n = 400) = 32.003, p<.05), whereas the national averages showed stability (χ^2 = .325, p>.05). Investigating self-regulation appears relevant, as talented athletes may have developed a high sense of self-regulation in sports, which may enable them to optimally profit from their self-regulatory skills in their academics.

Keywords: *Sport talent; educational level; self-regulation; talent development*

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Introduction

Talented athletes and academics have been subject of continued debate. For years, it was assumed that top-level sports at school age may be negatively linked with academic achievements (Umbach, Palmer, Kuh, & Hannah, 2006). Important talent years (ages 12–18 in most sports) is the period in which the most progress must be made in sports in order to reach expert performance, but at the same time it is also a period of immense pressure at school (Brettschneider, 1999). As a consequence, talented athletes are repeatedly confronted with the stress resulting from the demands of both domains. The negative combination of sports and academics is supported by early research findings, indicating that talented athletes have lower graduation rates (Purdy, Eitzen, & Hufnagel, 1982), lower grade point averages (Purdy et al., 1982), and difficulties in formulating educational goals (Sowa & Gressard, 1983) compared with their regular peers. With regard to the above-mentioned research findings, it should be acknowledged that most early research has been conducted in situations where sports and academics were united (i.e., at American high schools, colleges and universities).

By contrast, recent research suggests that talented athletes tend to perform well not only in sports but also in the academic

setting (Brettschneider, 1999; Durand-Bush & Salmela, 2002; Umbach et al., 2006; Watt & Moore, 2001). These studies report that talented athletes have higher report and graduation rates in comparison with fellow students that are less athletic (Watt & Moore, 2001) and that they are highly motivated to perform well in academics (Umbach et al., 2006). Moreover, as a result of the extensive commitment toward their sports, elite athletes are used to work on self-conscious, goal-oriented, and problem-focused behaviors in a goal-directed environment by the goal of improving their performances (Durand-Bush & Salmela, 2002; Orlick & Partington, 1988; Van Yperen & Duda, 1999). This is also reflected in their capability to manage a tight schedule between training, competitions and going to school (Durand-Bush & Salmela, 2002), and their ability to use their free time more economically when compared with the regular adolescent population (Brettschneider, 1999).

In recent decades, the social and economical importance granted to sports performance has grown and professionalization in most sports occurred (Oackley & Green, 2001). Simultaneously, sports levels increased enormously, which is illustrated by fast transitions in world records, an increase in physical capacities (e.g., aerobic capacity in soccer; Stølen, Chamari, Castagna, & Wisløff, 2005), a higher importance of cognitive aspects (e.g., tactical skills and decision-making; Del Villar, Gonzalez, Iglesias, Moreno, & Cervello, 2007; Vaeyens, Lenoir, Williams, & Phillippaerts, 2007), an increase in training hours (e.g., up to 30 hours per week in adult elite players; Ericsson, Krampe, & Tesch-Römer, 1993) and also by adaptations in the content of the training (e.g., periodization and optimalization of training methods per sport; Bompa, 1999). As part of this phenomenon and in combination with the professionalization of sports, the discussion of schools with special provisions for talented athletes has been intensified in many countries (Metsä-Tokila, 2002).

Talented athletes make an above-average investment in terms of time and psychological energy to their sport (Brettschneider, 1999; Watt & Moore, 2001). Having access to facilities, funds, adequate equipment, sufficient supervision and flexible educational institutions and training schedules seem required for a successful combination of sports and academics (Durand-Bush & Salmela, 2002; Metsä-Tokila, 2002). It has been recognized that combining sports and education without any special provisions is difficult. Thus educational institutions in which top-level training and education are integrated were established in many countries (Stichting LOOT & Sardes, 2001; Metsä-Tokila, 2002).

In the Netherlands too, 23 schools with special provisions were founded in recent decades. Several provisions (i.e., flexibility in school timetable, exemptions, delay of homework, special supplies to overcome delays incurred by training and games, delay or adaptations of periodic exams, supervision of a mentor, and/or examination regulations) are offered to them that aim at facilitating top-level sports and in the meantime gaining an academic degree at the highest level feasible (Stichting LOOT & Sardes, 2001). Yet, the final diploma is of the same level as that of their age peers.

The professionalization of sports has also resulted in improvements in career prospects. It is well known that, in contrast to decades ago, today's talented athletes foresee sufficient-to-excellent prospects in top-level sports, and those prospects may be even better than in their academic career. From this perspective, it might well be possible for a certain type of student athlete to choose a career in sports, whereas several years ago he or she would have chosen academic prospects. Nevertheless, the academic achievements of talented athletes are still considered important, since only a few of them will reach top level in sports and consequently make a living at it (Brettschneider, 1999).

Numerous studies have been conducted on young elite athletes and their academic achievements (e.g., differences between young elites and regular age-matched peers on for example grade point average, graduation rates, motivation, and educational goals; Purdy et al., 1982; Sowa & Gressard, 1983; Umbach et al., 2006; Watt & Moore, 2001). However, to the authors' knowledge, differences between today's talented athletes and talented athletes 14 years earlier have not been investigated, nor has a possible trend in the academic achievements of these athletes. Hence the purpose of this study is to gain insight into the link between the competitive sport level and the academic achievements of today's talented athletes and those 14 years earlier in a Dutch sample. It was chosen to investigate level of education (i.e., pre-vocational or pre-university level) as main standard of academic achievements, since in the Dutch educational system, with its variety of secondary education levels, the attained graduation level is the most important predictor for academic prospects (Inspectie van het Onderwijs, 2008). Since it might be possible for such a feature as level of education to attend at the pre-university level while the actual performances in class are below that of fellow students, we also targeted our investigations at the percentage of talented athletes with difficulties in class such as athletes with an unsatisfactory average and school repeaters. Whereas the level of education refers to a more national feature, the percentage of talented athletes with an unsatisfactory average and the percentage of school repeaters add to the generalizability of this study across countries because of its consistency with international literature. With regard to the competitive sport level, the Netherlands are known for their high-level talent development programs so it is no surprise that they have established a permanent top-20 position in the world ranking (Breedveld & Tiessen-Raaphorst, 2006, pp. 285–288).

Method

Participants

A total of 400 talented athletes participated in this study. All athletes were classified as 'talented athletes' on the basis of their qualifications by the Netherlands Olympic Committee and Sports Federation (NOC*NSF) and were therefore all part of a talent program. Of this total of 400 talented athletes, 200 attended secondary education in 1992/1993 (136 male and 64 female) and 200 in 2006/2007 (136 male and 64 female), which are two regular years within Dutch education. The mean age of the 1992/1993 talented athletes was 15.1 years (SD = 0.7) and that of the 2006/2007 athletes was 14.9 years (SD = 0.8). The total population consisted of 235 athletes playing team sports (field hockey, soccer, and volleyball) and 165 athletes playing individual sports (judo, speed skating, and tennis) with a similar distribution between team and individual sports over the 1992/1993 and 2006/2007 population respectively. Both ath-

letes in 1992/1993 and those in 2006/2007 were subdivided into two subgroups according to the level of secondary education, that is, pre-vocational or pre-university level. In this perspective, pre-vocational education refers to the academic level that serves as introduction to middle vocational education (i.e., ISCED level 4 and 5). Pre-university education refers to the academic level that prepares students for the university level (i.e., ISCED level 6; International Standard Classification of Education, 2006). All talented athletes in 2006/2007 were also part of a school with special provisions. Table 1 shows the general characteristics of the population.

Procedure

All participants were informed about the procedures and were told that the results would be used anonymously before providing their verbal permission to participate. Parents, sports federations, and schools gave their consent for the study to proceed. The procedures were in accordance with the standards of the local medical ethics committee of the University of Groningen.

Instruments

A questionnaire was used to investigate the academic achievements as well as the competitive sport level of the athletes in 1992/1993 and those in 2006/2007. All athletes were subsequently divided into two subgroups according to the type of school they attended, that is, pre-vocational level or pre-university level. Two standards of academic achievements (i.e., percentage of athletes with an unsatisfactory average and percentage of school repeaters) were assessed to indicate difficulties in class. These standards were also used to determine possible differences between the athletes in 1992/1993 and those in 2006/2007.

Table 1. Mean age, number of training hours per week, number of games per week and number of sport (i.e., training + games) per week (and standard deviations) for the talented athletes in 1992/1993 and the talented athletes in 2006/2007.

	TA 1992/1993		TA 2006/2007	
	(*n* = 200)		(*n* = 200)	
	M	*SD*	*M*	*SD*
Age (yrs)	15.1	0.7	14.9	0.8
Training (h/wk)	5.2*	3.1	7.1[a]*	1.7
Games (h/wk)	1.8*	1.5	2.5*	1.7
Sport (h/wk)	7.0*	3.4	9.6[a]*	2.7

Note. TA = talented athletes; *M* = mean; *SD* = standard deviation. [a] One missing value. * $p < .01$

Data analyses

All data were analyzed using SPSS 14.0. Descriptives were used to present the percentage of talented athletes per educational level. The national averages used in this study were adopted by the CBS (Central Bureau of Statistics) and are based on the 10th grade of high school (i.e., ages 15–16; CBS, 1994; 2008, p. 153).

Data were analyzed using four separate χ^2 statistics. The first χ^2 statistic was conducted to examine possible differences between the 1992/1993 and 2006/2007 national averages. The second χ^2 statistic was used to compare the talented athletes in 1992/1993 with the 1992/1993 national average. A similar χ^2 statistic was conducted in which we compared the 2006/2007 talented athletes with the 2006/2007 national average. We used a fourth type of χ^2 statistic to investigate whether the distribution of talented athletes in 1992/1993 attending pre-university level differed from that of talented athletes in 2006/2007.

Descriptives were also presented for the percentage of talented athletes with difficulties in class (i.e., the percentage of athletes with an unsatisfactory average and the percentage of school repeaters) for 1992/1993 and 2006/2007 respectively. We subsequently carried out a χ^2 statistic, in which we compared the athletes in 1992/1993 with those in 2006/2007 on the difficulties they have in class. The Bonferroni method was used to correct for multiple testing. An alpha of .05 was adopted for all tests of significance.

Results

The percentages of talented athletes per educational level and the national averages are shown in Table 2 and Figure 1. The results of the χ^2 statistic showed no significant difference between the national averages of 1992/1993 and 2006/2007 [$\chi^2 = 0.325$, $df = 1$, $p = .569$], indicating that there exists a relative stability in the ratio of regular youth attending pre-university level in 1992/1993 and in 2006/2007. A significant effect was found for the athletes in 2006/2007: they were significantly more often attending pre-university schools, whereas the national average shows that their fellow students that are less athletic were present more often at the pre-vocational level [$\chi^2 = 57.001$, $df = 1$, $p = .00$]. The athletes in 1992/1993 did not differ significantly from the national averages of that year [$\chi^2 = 3.617$, $df = 1$, $p = .057$]. The fourth χ^2 statistic showed that the athletes in 2006/2007 more frequently attended schools at the pre-university level than the athletes in 1992/1993 [χ^2 (1, $n = 400$) = 32.003, $p = .00$].

Figure 2 shows the percentage of talented athletes with an unsatisfactory average, the percentage repeaters and the total percentage of talented athletes with difficulties in class for 1992/1993 and 2006/2007 respectively.

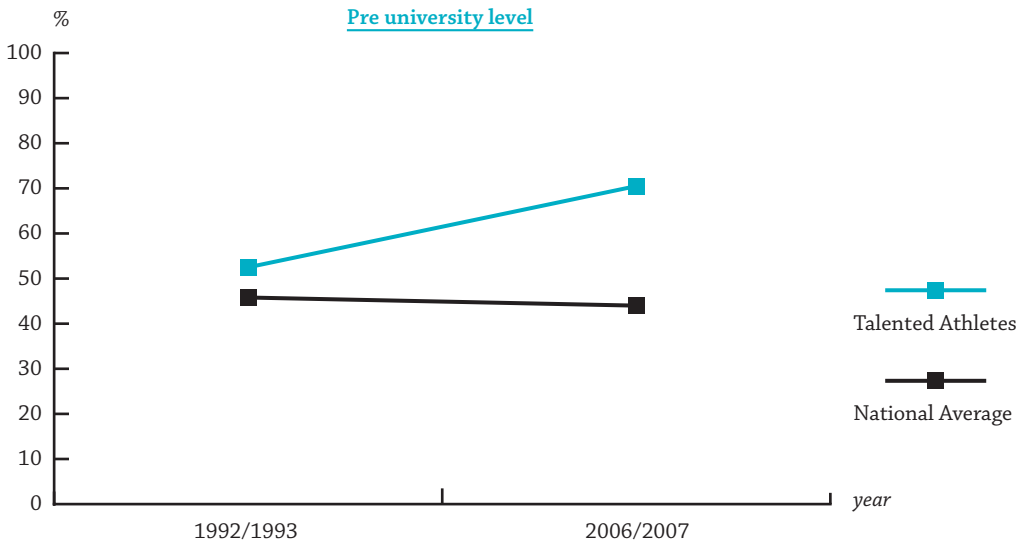
The results showed no significant differences between the athletes in 1992/1993 and these in 2006/2007 on the percentage of talented athletes with an unsatisfactory average [χ^2 (1, $n = 400$) = 0.093, $p = .760$], the percentage of school repeaters [χ^2 (1, $n = 400$) = 0.354, $p = 1.00$] or the total percentage of talented athletes with difficulties in class [χ^2 (1, $n = 400$) = 0.020, $p = .888$].

Table 2. Percentage of students per educational level for the national averages in 1992/1993 and 2006/2007 (CBS, 1994; 2008, p. 153) and for the talented athletes in 1992/1993 and 2006/2007 (N = 400) in the 10th grade of high school (i.e., ages 15-16).

	1992/1993		2006/2007	
	Na (%)	TA (%) (n = 200)	NA (%)	TA (%) (n = 200)
PVoc	54.2	47.5[b*]	56.0[a*]	29.5[ab*]
PUni	45.8	52.5[b*]	44.0[a*]	70.5[ab*]

Note. NA = national average; TA = talented athletes, PVoc = pre-vocational level, PUni = pre-university level.
[a] difference between NA and TA (2006/2007); [b] difference between TA 1992/1993 and 2006/2007. * $p < .01$.

Figure 1. Percentage students attending at the pre-university educational level for the national averages in 1992/1993 and 2006/2007 and the talented athletes in 1992/1993 and 2006/2007.



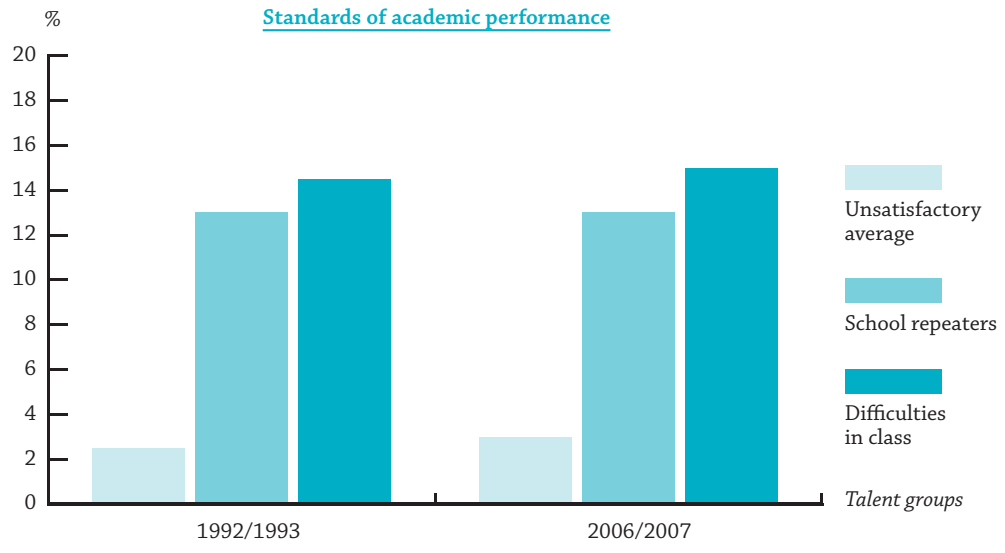
	1992/1993	2006/2007
National Average	45.8 %	44.0 %
Talented Athletes	52.5 %	70.5 %

Discussion

The purpose of the present study was to gain insight into the link between the sport competitive level and academic achievements of talented athletes in 1992/1993 and 2006/2007 in the 14–16 age range. To accomplish this, the athletes were compared with the national averages of 1992/1993, 2006/2007, and with each other on the percentage of students attending pre-university programs. Furthermore, two standards (i.e., percentage of talented athletes with an unsatisfactory average and percentage of school repeaters) were assessed to investigate possible difficulties in class.

Our results show no difference between the national averages of 1992/1993 and 2006/2007, which indicates a relative stability in the ratio of regular youth attending pre-university level over the years. According to the Dutch Inspectorate of Education (2008), the quality of the educational level also remained stationary (Inspectie van

Figure 2. Percentage of talented athletes with an unsatisfactory average, the percentages of school repeaters and the percentage of talented athletes with difficulties in class (unsatisfactory average + school repeating) for the athletes in 1992/1993 and in 2006/2007.



	1992/1993	2006/2007
Unsatisfactory average	2.5 %	3.0 %
School repeaters	13.0 %	13.0 %
Difficulties in class	14.5 %	15.0 %

het Onderwijs, 2008, fig. 4.1a, p. 71).

With regard to academic achievements of the talented athletes in 2006/2007, the results reflected significant differences between the athletes and the national average of that year. They attended schools with pre-university level of education more frequently than the percentage of the regular youth. These results are in congruence with recent findings reporting that today's talented athletes not only tend to perform well in sports but also in academic settings (Dexter, 1999; Durand-Bush & Salmela, 2002). The athletes in 1992/1993 appeared to attend more frequently at the pre-university level, however did not differ significantly from the national averages of that year. This might be a first indication for the increase in the educational level of talented athletes competing at high competitive sport levels over the years. Our finding that the athletes in 2006/2007 attend pre-university schools more frequently than 14 years earlier extends this proposition. In addition, the increase in the level of education of talented athletes is not accompanied by an increase in difficulties in class.

The current research findings have important implications, since they might suggest that sports and academics not only can complement each other (Durand-Bush & Salmela, 2002), but moreover, sports may actually be beneficial for the academic achievements of these athletes competing at high competitive sport levels. As indicated above, our results suggest that the demands upon the students' educational capacities remained stationary over the years, that is, attending schools at the pre-university level in 1992/1993 is comparable with 2006/2007. By contrast, the competitive sport level and the number of hours devoted to training has increased over the years (Ericsson et al., 1993; Oackley & Green, 2001). In the present study we found that the athletes in 2006/2007 spend significantly more time in training and also have a lower variability when compared with the athletes in 1992/1993 (see means and standard deviations in Table 1), which supports the above-mentioned literature. Thus, it is suggested that whereas in early years it might have been possible to compensate for relatively low innate talent with a lot of training, or vice versa, it appears that today's talented athletes can only reach elite level in sports by a combination of innate talent and time-intensive sports training. Despite of the increase in their extensive investments in sports, they are more frequently attending schools at the pre-university level.

Yet other components, such as special provisions provided to the talented athletes and improved career prospects, may play a role in our research findings. With regard to the provisions, the athletes in 2006/2007 appear to have an advantage over the athletes in 1992/1993 and regular students since all of them are part of a school with such extras. Nevertheless, we assume that those extra provisions only have a secondary influence on the level of education. In a recent study on young promising athletes at regular schools, a similar percentage of talented athletes was attending in pre-university classes (i.e., 71.7%; Stichting LOOT, personal communication, September 5, 2008). As a consequence, we propose that only those athletes at the highest sport performance levels in terms of international competitive sport level, number of training hours and type of sport do meet the needs for special provisions. Moreover, also the athletes competing at international levels in 1992/1993 had access to extra assistance at school, albeit not statutorily arranged. Yet, within the Dutch educational system, all students are used to the possibility to ask for extra supervision or help by a mentor if required. We therefore assume that our assumption that talented athletes are also high achievers academically is not based on differences in instruction caused by the special provisions offered to them.

With regard to the improved career prospects in sports, it might be possible that another type of student athlete chooses a career in top-level sports. More specifically, several years ago the academic prospects for talented athletes at pre-university level were more promising, whereas today's talents foresee sufficient-to-excellent career opportunities in their sports. In addition, by the indivisible trinity between today's professional sport, sponsorships, and media, the career possibilities of retired athletes have increased. For example, many former athletes enter a new career working as coaches, managers, or as experts commenting on sport events on television (Metsä-Tokila, 2002; Smart, 2005, p. 144). Nevertheless, the question remains – which qualitative characteristics related to sports may be beneficial towards increasing the educational level of talented athletes?

In recent decades, considerable research into sports has focused on the development and maintenance of athletic ability. In this perspective, it is more and more acknowledged that expert performance in sports not only depends on innate physical characteristics and physical training but may be even more attributable to cognitive factors (Cleary, Zimmerman, & Keating, 2006). Experts in sports outperform their non-expert counterparts on several factors related to cognition such as sport-specific knowledge (Dexter, 1999), decision-making (Del Villar et al., 2007; Vaeyens et al., 2007), tactical skills (Del Villar et al.; Elferink-Gemser, Visscher, Lemmink, & Mulder, 2004), perceptual skills (Vaeyens et al.), and self-regulatory skills (Cleary & Zimmerman, 2001; Cleary et al., 2006).

Because we are interested in the association between competitive sport level and the educational level of talented athletes, we assume that self-regulation appears to be one of the most promising venues for further investigation. Self-regulatory theories appear to fit with previous studies reporting that elite athletes are used to work on self-conscious, goal-oriented, and problem-focused behaviors (Durand-Bush & Salmela, 2002; Orlick & Partington, 1988; Van Yperen & Duda, 1999). In addition, both in sports and in academic settings studies indicate that experts within the specific domains have superior self-regulatory skills than non-experts (Cleary & Zimmerman, 2001; Ertmer & Newby, 1996; Zimmerman, 1998) and that similarities exist between athletic and academic tasks (Zimmerman & Kitsantas, 1996). More specifically, because of its characteristics and its generality, self-regulatory skills can be transferred from one context, in which it was developed, to another (Boekaerts, 1999; Ferrari, Pinard, Reid, & Bouffard-Bouchard, 1991; Kirschenbaum, 1984). According to Zimmerman (1986), self-regulation refers to cognitive, motivational, and behavioral processes used by learners to advance their own learning processes. Besides its relevance in expert performance, the importance of self-regulation has also been identified in related areas such as in effective time management and high level achievements in competitive situations (Moon, 2003; Zimmerman & Martinez- Pons, 1986).

In conclusion

The results of this study indicate that talented athletes are also academically high achievers and it postulates that these athletes might benefit from well-developed characteristics such as self-regulatory skills in sports in academic situations. From this study, this may be reflected in the ratio of talented athletes attending at the pre-university level. With respect to the above-mentioned postulation, future studies should investigate the self-regulatory skills of talented athletes. In addition, self-regulation may also be useful in distinguishing skilled from less skilled youth at young age and may help talented athletes to overcome the stress related to the combination of sports and academics by balancing their sport and academic activities better. Moreover, further investigation is warranted with respect to regular youth as also mainstream children and adolescents may profit from a well-developed sense of self-regulation in improving their academic achievements.

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Chapter 4

The role of self-regulatory skills in sport and academic performances of elite youth athletes

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Abstract

Success in sport and school is related to self-regulation. Additionally, sport experts are high academic achievers. We examined the role of 6 self-regulatory skills in the sport and academic performances of elite youth athletes (12-16 years) and compared their scores with age-matched controls in 2 academic secondary school systems (pre-university vs. pre-vocational). Pre-university students outscored pre-vocational students on 5 self-regulatory skills in the control group while 2 skills were significant in an athletes' population. When comparing elite athletes to controls within each academic system, 3 self-regulatory skills were significant. Moreover, pre-vocational athletes outscored pre-university controls on 1 skill. These results expand theories of transfer by suggesting that self-regulation may help elite youth athletes to combine a sport career with education.

Keywords: *Talent development, metacognition, motivation, sport, academics*

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Introduction

Even though elite youth athletes are frequently under excessive time pressure as a consequence of having to juggle their academic careers with their extensive investment in sports, they still tend to be high academic achievers (Brettschneider, 1999; Durand-Bush & Salmela, 2002). Student athletes generally have superior graduation rates (Watt & Moore, 2001) and are also more frequently in the pre-university system than fellow students who are less athletic (Jonker, Elferink-Gemser, & Visscher, 2009). In The Netherlands, students can enter two academic systems; the pre-university system or the pre-vocational system. The former prepares students for a university career and students are granted admission based on their test scores, while the latter prepares students for later vocational education. The academic system students enter thus determines their level of graduation and thereby their future career prospects. Within each academic system students can fail classes, which in The Netherlands means that students have to retake the entire year.

Self-regulation is important in both sports and secondary education. Expert athletes exhibit more self-regulatory skills than non-experts in sports (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002), and

at the higher academic levels typically more students can be found with superior self-regulatory skills (Zimmerman, 1986; Zimmerman & Martinez-Pons, 1986). It has, therefore, been suggested that the possession and use of self-regulatory skills predicts academic achievement (Nota, Soresi, & Zimmerman, 2004; Zimmerman & Martinez-Pons). The question arises whether self-regulatory skills may contribute to elite youth athletes' academic performances as well as to their sport performance.

There is a long history of debate regarding the generality vs. domain-specificity of self-regulation and the possibilities for learners to use self-regulatory skills gained in one domain to progress in another (i.e., possibility for transfer). There is evidence for transfer failure and transfer success (e.g., Boekaerts & Corno, 2005; De Corte, 2003; Veenman, Elshout, & Meijer, 1997; Veenman & Spaans, 2005). This inconsistency in data may be due to how a successful transfer is conceptualized (De Corte; Veenman & Spaans). The traditional approach takes a narrow view for evidence of transfer (i.e., independent and instant use of knowledge and skills obtained in one domain transferred to another domain), whereas more recent conceptualizations emphasize a broader view (i.e., knowledge, skills and motivations obtained in one domain foster the use of skills in another domain) in which self-regulatory skills play a role (De Corte). Nevertheless, it is assumed that successful transfer is related to a similarity and to familiarity with the elements of a task (De Corte; Eccles & Feltovich, 2008; Pressley, 1995; Zimmerman, 1995).

Based on the broader conceptualization of transfer, the idea was to investigate the use of self-regulatory skills as potential moderators between excellent sport achievement and academic achievement in elite youth athletes (Jonker et al., 2009). Even though there seems to be little overlap between the respective elements of sport and academic performances, the factors that contribute to success in both domains may be highly correlated and have a common basis, namely a general set of self-regulatory skills. It has been proposed that elite athletes are familiar with the use of self-regulatory skills because of their familiarity with the domain-specific knowledge (i.e., declarative and procedural) that serves as a basis for self-regulatory skills. Additionally, elite youth athletes understand that they must be self-aware, goal-oriented and problem-focused to study and achieve their goals within various performance domains (Ericsson, Krampe, & Tesch-Römer, 1993; Kirschenbaum, 1984; Winne, 1995). These characteristics are consistent with the top-down approach of self-regulation in which students adopt their learning goals (Boekaerts & Corno, 2005). From the bottom-up perspective, it is suggested that students develop self-regulation by continuous instruction and feedback from their environment (e.g., coaches, trainers and teachers) to adapt their learning styles (Boekaerts & Corno; Pintrich & Zusho, 2002). In this perspective, the sport domain may form a suitable environment in which to develop self-regulatory skills. Athletes are forced to set personal improvement goals and they continually receive feedback from the action itself (i.e., success or failure) and from coaches on the performance process. Therefore, the present study focused on the role of self-regulatory skills in the sport and academic performances of elite youth athletes.

In the present study we relied on Zimmerman's self-regulated learning theory (1989, 2000, 2006) and the expert learning model of Ertmer & Newby (1996). Zimmerman (1986, 1989, 2006) defined self-regulation as the degree to which learners are metacognitively, motivationally and behaviourally proactive participants in the learning process. As a result, metacognition is defined as awareness of and knowledge about one's own thinking and the skills of planning, self-monitoring, evaluation and reflection were adopted (Ertmer & Newby, 1996; Zimmerman, 1986, 2006). Zimmerman's (2000) self-regulation theory distinguishes three cyclical phases of self-regulation: a forethought phase (i.e., goal setting and planning), a performance phase (i.e., use of strategies to improve the quality and the quantity of learning) and a reflection phase (i.e., strategies that include evaluating different parts of the performance after learning). The expert learning model of Ertmer & Newby was based on Zimmerman's work, but emphasizes the importance of reflection. These authors describe reflection as the active process of learning from past experience and applying prior knowledge and experience to improve current or future actions (Ertmer & Newby).

Students or athletes not only have to possess the above mentioned metacognitive skills, they also need to be motivated to use them (Zimmerman, 1989, 2006). Motivation is defined as the degree to which learners are self-efficaciously, autonomously, and intrinsically motivated to achieve a specific goal and includes effort and self-efficacy (Hong & O'Neil Jr., 2001). Furthermore, learners not only need metacognition and motivation, they must also use these skills within particular situations (Hong & O'Neil Jr.; Zimmerman, 1990).

In sum, previous studies report that elite youth athletes are not only high athletic performers, but are also high academic achievers. Sport experts outperform non-experts on self-regulation, which is a prerequisite for success at school as well (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002; Nota et al., 2004). Therefore, our aim was to examine the role of self-regulatory skills in the sport and academic performances of elite youth athletes. We compared elite youth athletes and non-athletes on six self-regulatory skills (i.e., planning, self-monitoring, evaluation, reflection, effort and self-efficacy) in the pre-vocational and pre-university systems. We hypothesized that students in the pre-university system would outscore their pre-vocational peers in self-regulatory skills (Cleary & Zimmerman; Kitsantas & Zimmerman; Nota et al). Furthermore, because sport participation seems to promote self-regulatory skills (Pintrich & Zusho, 2002), and because international elite youth athletes are more reflective when compared with those at national level (Jonker, Elferink-Gemser, & Visscher, 2010), we expected elite youth athletes to score high on self-regulation, including reflection, independent of the academic system. We also wished to determine whether elite youth athletes in the pre-vocational system displayed higher levels of self-regulation than their pre-university non-athletic peers. Personal characteristics such as age, gender and socioeconomic status (SES) were taken into account. Prior research showed that older students are generally more self-regulatory than their younger counterparts (Al-Hilawani, 2003; Pintrich & Zusho; Zimmerman & Martinez-Pons, 1990). Furthermore, inconsistent findings have been reported in the use of self-regulatory skills between males and females (Anshel & Porter, 1996; Zimmerman & Martinez-Pons), and students lower in SES are associated with lower levels of sports par-

ticipation, lower levels of self-regulation and more academic problems (Nota et al.; Sirin, 2005).

Assessing the role of self-regulatory skills in the sport and academic performances of elite youth athletes may provide insight regarding the possibility that these athletes utilize self-regulatory skills not only in sports, but also in the academic setting. This insight may help elite youth athletes to combine sport with educational responsibilities, and the combination of these two factors is especially important for athletes aged 12 to 16 years. At this age, athletes have to improve most to reach senior elite levels of competition, but this age is also a period of immense pressure at school (Brettschneider, 1999).

Method

Participants

A total of 160 male and 178 female students (n = 338) aged between 12 and 16 years participated in this study. Altogether, 170 were classified as elite youth athletes (77 male and 93 female; mean age = 14.18 yrs, SD = 1.17) on the basis of their participation in a talent development program in The Netherlands. This means that they were considered to belong to the best 2.5% of athletes in their age category. About half (n = 83) played team sports (i.e., baseball, basketball, handball, field-hockey and volleyball) while the other half (n = 87) took part in individual sports (i.e., gymnastics, judo, speed-skating, swimming, and tennis). The elite youth athletes had approximately 4000 hours of accumulated sport experience (mean 4084.45, SD = 1576.45). This is equal to approximately 560 hours of training practice per year (M = 558.30, SD = 185.25). Additionally, 78.8% of the athletes (n = 134) were part of the pre-university system and 21.2% of them (n = 36) were in the pre-vocational system.

The other 168 students (83 male and 85 female; mean age = 14.26 yrs, SD = 1.18) were designated as non-athletes based on their self-reported activities (i.e., they reported that they were not active in sports at the time of measurement and had a maximum of four years of sport experience in the past). Within this population of non-athletes, 47.6% of them (n = 80) were part of the pre-university system and 52.4% of them (n = 88) were in the pre-vocational system. Table 1 shows the general characteristics of the study groups.

Table 1. Mean age, number of training hours per week, number of games per week (and standard deviations), gender, socioeconomic status (SES), and re-taking an entire year of study (n [%]) for the elite youth athletes and the non-athletes in the pre-university or pre-vocational academic system.

	Pre-university		Pre-university		Pre-vocational			
	Elite youth athletes (n = 134)		Non-athletes (n = 80)		Elite youth athletes (n = 36)		Non-athletes (n = 88)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age (yrs)	14.19[a]	1.21	14.39[a]	1.22	14.14[a]	0.96	14.05[a]	1.13
Training (hrs/week)	10.91[a]	3.74	0.00[b]	0.00	10.09[a]	2.73	0.00[b]	0.00
Games (hrs/week)	3.84[a]	3.09	0.00[b]	0.00	5.02[a]	4.01	0.00[b]	0.00
	n	%	*n*	%	*n*	%	*n*	%
Gender								
Male	62	46.3[a]	40	50.0[a]	15	41.7[a]	43	48.9[a]
Female	72	53.7	40	50.0	21	58.3	45	51.1
SES								
Low	6	4.5[a]	3	3.8[a]	7	19.4[b]	19	21.6[b]
Middle or high	128	95.5	77	96.2	29	80.6	69	78.4
Re-take an entire year								
Never	123	91.8[a]	61	76.2[b]	28	77.8[b]	67	76.1[b]
Once or more	11	8.2	19	23.8	8	22.2	21	23.9

Note. Within each row, means having the same letter in their superscripts are not significantly different from each other at the .05 level.

Instruments

To obtain the demographic details of the participants and to assess their involvement in sports and their self-regulatory skills, all participants completed a questionnaire specially compiled for this study.

General questions

Participants noted their date of birth, gender, and the 4-digit zip code of their place of residence. The 4-digit zip code was compared to a list published by the Dutch Ministry of Housing, Spatial Planning and the Environment specifying Dutch neighbourhoods low in socioeconomic status (SES). SES refers to an aggregate standard for the household family income, education, occupation and residential neighbourhood. As it is assumed that people with a middle or high SES are sufficiently able to participate in sports and have similar academic propositions, we used SES as a dichotomous variable (i.e., low vs. middle or high in SES). Participants also stated which sports they were involved in, the number of hours spent on training and games, the number of years they had been active in sports and whether they have ever had to retake a full year of study. Whether the participants were registered in the pre-university or pre-vocational system was recruited from the schools' databases.

Self-regulation items
The six aspects of self-regulation were assessed using subscales from several existing questionnaires (Herl et al., 1999; Hong & O'Neil Jr., 2001; Howard, McGee, Sia, & Hong, 2000; Peltier, Hay, & Drago, 2006; see below). The subscales were translated from the originals in accordance with the procedures described by Pelletier and colleagues (1995). First, two native speakers of Dutch proficient in English translated the original English subscales into Dutch. The Dutch translations were then back-translated into English by two other bilingual individuals who had no knowledge of the original subscales. The resultant translations were evaluated by all translators and a Professor in Human Movement Sciences, which led to seven minor linguistic modifications. This version was tested on 48 children, aged 11 to 14 years, the youngest age band in our target group, who were asked to point out what was too difficult. Based on their comments we made some final linguistic modifications to increase the intelligibility of the items.

With respect to the reliability and validity of the questionnaire, we performed a confirmatory factor analysis among 601 adolescents who were between 11 and 17 years of age. Multiple conventional criteria were used to evaluate our results (i.e., comparative fit index [CFI] and non-normed fit index [NNFI] > .90, root mean square error of approximation [RMSEA] < .08, and standardized root mean residual [SRMR] < .08; Byrne, 1998; Hu & Bentler, 1999). The results of our factor analysis were: CFI = .95, NNFI = .94, RMSEA = .060, SRMR = .063, and we concluded that the factor analysis showed satisfactory results for an adjusted six-factor model. A second confirmatory factor analysis (n = 600) cross validated these results. Additionally, Cronbach's alphas for each scale in the current study ranged from α = .76 on self-monitoring to α = .88 on effort which is considered acceptable (i.e., >.70; Nunally, 1978), and consistent with the original studies (i.e., Cronbach's alphas between α = .72 and α = .85; Herl et al., 1999; Hong & O'Neil Jr., 2001; Howard et al., 2000; Peltier et al., 2006).

Planning, self-monitoring, effort, and self-efficacy
The subscales for planning, self-monitoring, effort and self-efficacy were adapted from Hong and O'Neil Jr. (2001) and Herl and colleagues (1999). All subscales consisted of 6 to 10 items and participants needed to rate each item on a 4-point Likert type scale ranging from 1 (*almost never*) to 4 (*almost always*). High scores on these four self-regulation subscales indicated a high level of metacognitive and motivational self-regulation in general task situations. The planning scale gauges the respondent's awareness of the demands of a task prior to its execution, and an example of a question reads, "I determine how to solve a problem before I begin". The self-monitoring scale evaluates the awareness the respondent has of his or her actions during task execution (e.g., "I keep track of my progress"), while the effort scale measures the respondent's willingness to apply himself or herself to attaining the set goal (e.g., "I work as hard as possible on all tasks").

Self-efficacy, which is how the respondent judges his or her capabilities to organize and execute the required actions, was assessed using the Generalized Self-Efficacy scale. An example response on this scale would be "No matter what comes my way, I am usually able to manage it" (Hong & O'Neil Jr, 2001; Schwarzer & Jerusalem, 1995). While the authors are aware that there are separate domain-specific self-efficacy scales for sports and academic performance (Bandura, 1997), we used a general measure to be consistent with the other subscales. Using a general measure for self-efficacy is less accurate but can be valuable as well (Bandura).

Evaluation
The eight-item Inventory of Metacognitive Self-Regulation (IMSR) subscale, developed by Howard and colleagues (2000), was used to examine evaluation. Evaluation is the ability to assess both the processes employed and the finished product after task completion. An example question is, "I go back and check my work". Participants responded to each item on a 5-point Likert scale that ranged from 1 (*never*) to 5 (*always*). A high score on the evaluation scale indicated that the respondent often evaluated his or her performance.

Reflection
The five-item Reflective Learning Continuum (RLC), by Peltier and colleagues (2006), was used to measure the extent to which respondents are able to appraise what they have learned and to adapt their past knowledge and experiences to improve performance. An example of a question is, "I often reappraised my experiences so I can learn from them". Because the items in the original subscale were written in the simple past tense, we changed the subscale into the simple present tense in order to maintain consistency with the other five subscales. Items were rated on a 5-point Likert scale ranging from 1 (*strongly agree*) to 5 (*strongly disagree*). Accordingly, low scores on the RLC indicated a high level of reflection. We reversed the scores for our analyses, such that high scores on this subscale indicated a high level of reflection.

Procedure
All of the participants were informed about the study's procedures and provided their verbal consent to participate. Written informed consent was obtained from their parents and the schools the participants attended. The participants filled out the questionnaire in a group setting during their regular school activities while in the presence of test leaders. The assessment occurred during the competitive season (i.e., March to May). The procedures were in accordance with the standards of the local medical ethics committee at the leading institution.

Analyses
Analysis of the data was conducted using SPSS 17.0. Descriptive statistics were calculated for the six self-regulatory skills (planning, self-monitoring, evaluation, reflection, effort and self-efficacy) for the elite youth athletes and the non-athletes according to the academic system they are involved in (pre-vocational or pre-university). To interpret the scores, effect-size correlations (r) were calculated. An effect size of approximately .100 was considered small, .243 moderate, and .371 large (Rosenthal & Rubin, 2003).

Five separate Hotelling's T^2 tests were performed. Hotelling T^2 tests have been shown to be more powerful in detecting small reliable changes when compared to the power of adjusted univariate techniques (Davidson, 1972). The first Hotelling's T^2 test compared the pre-university non-athletes to their pre-vocational non-athletic peers and was performed to assess the role of being part of the pre-university or pre-vocational system. The scores on the six self-regulatory subscales served as dependent variables and academic system as independent variable.

The second Hotelling's T^2 test com-

pared the elite youth athletes in the pre-university system to their non-athletic counterparts in this type of education. A similar Hotelling's T^2 test was conducted to assess differences in self-regulation between elite youth athletes in the pre-vocational system and their pre-vocational non-athletic peers. In both analyses, self-regulation served as the dependent variable and competitive level as the independent variable. These analyses were performed to assess the role of competitive level in the self-reported use of self-regulation, given that all athletes were part of the same academic system.

The fourth Hotelling T^2 test, was performed to evaluate the role of academic performance in a population of elite youth athletes. The scores on self-regulation served as the dependent variables while academic system served as the independent variable. The final Hotelling's T^2 test was performed to assess possible differences in self-regulation between the elite youth athletes in the pre-vocational system and the non-athletes in the pre-university system. Again, scores on the six subscales of self-regulation were considered the independent variables while the combined sports and academic levels were the independent variables.

In all five analyses, age, gender, SES and re-taking a year of study served as covariates. Correlational analyses (Pearson's *r*) revealed a weak positive relationship between competitive level and re-take a year of study, $r(336) = .176$; $p = .001$, and between academic system and SES, $r(336) = .265$; $p < .001$. A weak negative relationship existed between academic system and re-take a year of study, $r(336) = -.128$; $p = .018$. When the Hotelling's T^2 tests yielded significant effects, the univariate results were interpreted. For all tests of significance, an alpha level of .05 was adopted and the Bonferroni method was used to correct for multiple testing.

Table 2. Adjusted mean scores (*M*), standard errors (*SE*) and effect sizes (*r*) in order of the Hotelling T^2 tests on the six self-regulatory skills for the elite youth athletes and the non-athletes in the pre-university or pre-vocational academic system.

	Pre-university		Pre-university		Pre-vocational				Effect sizes for T^2 analyses				
	Elite youth athletes (n = 134)		Non-athletes (n = 80)		Elite youth athletes (n = 36)		Non-athletes (n = 88)		First T^2	Second T^2	Third T^2	Fourth T^2	Fifth T^2
	M	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*r*	*r*	*r*	*r*	*r*
Planning (Range 1-4)	2.68^{a}	.045	2.49^{b}	.060	2.39^{b}	.083	2.32^{c}	.057	$.149^{+}$	$.182^{+o}$	$.063^{+}$	$.225^{o}$	$.065^{+}$
Self-monitoring (Range 1-4)	2.80^{a}	.045	2.67^{a}	.060	2.72^{a}	.081	2.37^{b}	.057	$.290^{o\wedge}$	$.091^{+}$	$.303^{o\wedge}$	$.023^{+}$	$.032^{+}$
Evaluation (Range 1-5)	3.55^{a}	.044	3.53^{a}	.061	3.39^{a}	.086	3.18^{b}	.058	$.302^{o\wedge}$	$.028^{+}$	$.179^{+o}$	$.108^{+}$	$.090^{+}$
Reflection (Range 1-5)	4.17^{a}	.043	3.86^{b}	.067	4.13^{c}	.096	3.57^{d}	.064	$.228^{o}$	$.290^{o}$	$.409^{\wedge}$	$.010^{+}$	$.218^{o}$
Effort (Range 1-4)	3.04^{a}	.045	2.69^{b}	.058	2.86^{b}	.084	2.43^{c}	.055	$.242^{o}$	$.287^{o}$	$.361^{\wedge}$	$.145^{+}$	$.125^{+}$
Self-efficacy (Range 1-4)	2.98^{a}	.037	2.85^{ab}	.048	2.80^{b}	.070	2.63^{b}	.046	$.242^{o}$	$.143^{+}$	$.199^{+o}$	$.176^{+o}$	$.085^{+}$

Note. r = around .100 (small^{+}), r = around .243 (moderate^{o}), r = around .371 (large$^{\wedge}$). Within each row, means having the same letter in their superscripts are not significantly different from each other at the .05 level.
^{ab} The pre-university non-athletes are not significantly different from the pre-university elite youth athletes and from the pre-vocational elite youth athletes.

Results

Mean scores and standard deviations on the six self-regulatory skills for competitive level and academic system are presented in Table 2 as well as the corresponding effect sizes (*r*).

Self-regulatory skills and academic system

The results of the first Hotelling's T^2 test revealed that the pre-university non-athletes had higher scores on self-monitoring, $F(1,162) = 15.294$; $p = <.001$; $r = .290$, evaluation, $F(1,162) = 16.684$; $p < .001$; $r = .302$, reflection, $F(1,162) = 9.106$; $p = .003$; $r = .228$, effort, $F(1,162) = 10.299$; $p = .002$; $r = .242$, and self-efficacy, $F(1,162) = 10.339$; $p = .002$; $r = .242$ than their non-athletic peers in the prevocational system. The corresponding effect sizes were considered moderate. No significant result was found on planning ($p > .05$) and the effect size was considered small (Table 2). In addition, no significant effects were found for the covariates age, gender, SES and re-taking a year of study ($p > .05$).

Self-regulatory skills and competitive level

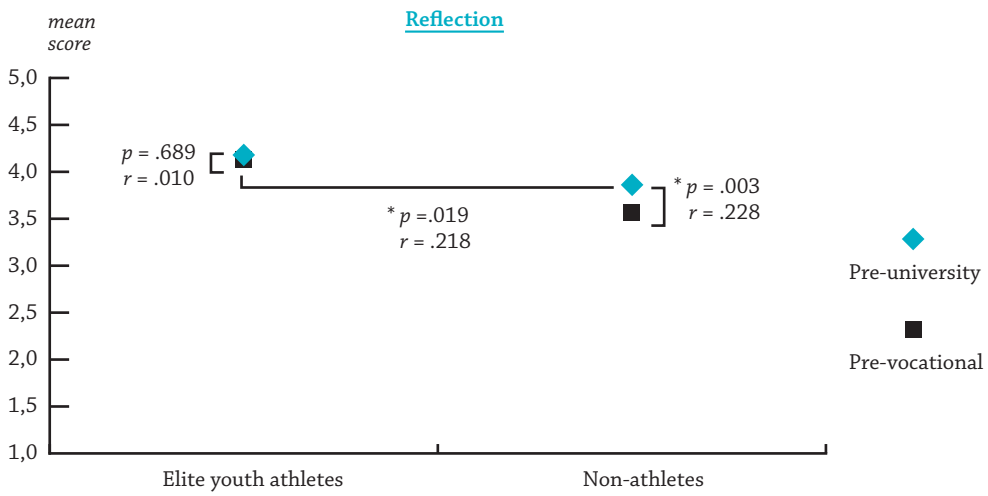
The results of the second Hotelling's T^2 test showed that the pre-university elite youth athletes outscored the non-athletes in this educational system on planning, $F(1,208) = 7.245$; $p = .008$; $r = .182$, reflection, $F(1,208) = 19.473$; $p < .001$; $r = .290$, and effort, $F(1,208) = 18.989$; $p < .001$; $r = .287$. The corresponding effect sizes were considered small-to-moderate on planning and moderate on reflection and effort. No significant differences were found on self-monitoring, evaluation and self-efficacy ($p > .05$), as well as small effect sizes (Table 2). In addition, the covariate age turned out to be significant, showing that older participants reported lower scores on effort than their younger counterparts, $F(1,162) = 9.106$; $p = .003$. The covariates gender, SES and re-taking a year of study yielded no significant results ($p > .05$).

Within the pre-vocational system, the results of the third Hotelling T^2 test revealed that the pre-vocational elite youth athletes outscored the pre-vocational non-athletes on self-monitoring, $F(1,118) = 12.313$; $p = .001$; $r = .303$, reflection, $F(1,118) = 24.570$; $p < .001$; $r = .409$, and effort, $F(1,118) = 18.315$; $p < .001$; $r = .361$. The effect sizes were considered large. No significant effects were found on planning, evaluation and self-efficacy ($p > .05$). The effect sizes ranged from small to small-to-moderate (Table 2). The covariates age, gender, SES and repeating class yielded no significant results.

Self-regulatory skills, competitive level x academic system

When assessing the value of the academic system the athletes are participating in (fourth Hotelling T^2 test), the results showed that the pre-university elite youth athletes had higher scores on planning, $F(1,164) = 8.994$; $p = .003$; $r = .225$, and self-efficacy, $F(1,164) = 5.392$; $p = .021$; $r = .176$ than the pre-vocational elite youth athletes. The effect sizes were considered moderate for planning and small-to-moderate for self-efficacy. No significant results were found on self-monitoring, evaluation, reflection and effort ($p >$

Figure 1. Interaction between competitive level and academic level on reflection.



	Elite youth athletes	Non-athletes
Pre-university	4.17	3.86
Pre-vocational	4.13	3.57

.05), as well as small effect sizes (Table 2). In addition, the covariate age yielded a significant result; older athletes had lower scores on effort than younger athletes, $F(1,164) = 3.582$; $p < .001$. The covariates gender, SES, and re-taking a year of study were not significant ($p > .05$).

The results of our fifth Hotellings T^2 test showed that the pre-vocational athletes had higher scores on reflection than the non-athletes in the pre-university system, $F(1,110) = 5.692$; $p = .019$; $r = .218$ (Figure 1). The corresponding effect size was considered moderate. No significant effects were found on the other five aspects of self-regulation ($p > .05$) and the effect sizes were small (Table 2). The covariates yielded no significant effects ($p > .05$).

Discussion

We examined the role of six self-regulatory skills (i.e., planning, self-monitoring, evaluation, reflection, effort and self-efficacy) in the sport and academic performances of elite youth athletes. Insight into the value of sports participation at high competitive level and being involved in either the pre-university or pre-vocational system, may clarify the possibility that elite youth athletes utilize their well-developed sense of self-regulation not only in sports, but also in the academic setting.

That non-athletes in the pre-university system outscore their pre-vocational non-athletic counterparts on five out of six self-regulatory skills is in line with previous studies reporting that academically successful students are more likely to monitor, evaluate and reflect upon their performances, that they have a better developed sense of self-efficacy and that they are more willing to exert themselves than their less academically successful peers (Bandura, 1993; Ertmer & Newby, 1996). Within a population of elite youth athletes on the other hand, only two self-regulatory skills (i.e., planning and self-efficacy) are significant when pre-university athletes are compared to their pre-vocational counterparts. These combined findings suggest that participation in junior elite sports may play a role in the self-reported use of self-regulatory skills of elite youth athletes since smaller differences between the academic systems are found when students participate in junior elite sports.

We also observed that the elite youth athletes in the pre-university system outscore their pre-university non-athletic counterparts on three self-regulatory skills (i.e., planning, reflection and effort). A similar pattern was found when comparing elite youth athletes to non-athletes within the pre-vocational system (i.e., self-monitoring, reflection and effort). These results further emphasize the significance of the relationship between sports participation at junior elite level and scores on self-regulation. More specifically, even when the non-athletes are part of the pre-university academic system, in which they are suggested to have above average levels of self-regulation (Nota et al., 2004; Zimmerman, 1986; Zimmerman & Martinez-Pons, 1986), the elite youth athletes in this academic system report more frequent use of their planning and reflective skills and also report to make more effort to succeed. More practically this means that the elite youth athletes have an increased awareness of a task's demands prior to its execution and are more conscious of their previous performances from which they are able

to learn (Ertmer & Newby, 1996; Peltier et al., 2006). Furthermore, they make more effort to succeed in achieving their goals (Hong & O'Neil Jr., 2001; Jonker et al., 2010; Toering, Elferink-Gemser, Jordet, & Visscher, 2009).

Within the broader concept of transfer, the results may suggest that elite youth athletes are able to use their well-developed self-regulatory skills in an academic setting as well. This may be reflected by the relatively high ratio of elite youth athletes in the pre-university system (i.e., 78.8%), whereas the percentage of the Dutch national average is far lower (i.e., 44.0%; CBS, 2008). Additionally, the percentage of elite youth athletes who have ever had to re-take a year of study is also significantly lower than for the non-athletes (i.e., 11.2% vs. 23.8% respectively; Table 1). This is consistent with previous research showing that approximately 70% of the elite youth athletes are in higher academic systems without other difficulties in class (Jonker et al., 2009). The relationship between self-regulation and involvement in junior elite sports seems to become more evident in the pre-vocational system. To elaborate, even though not all aspects reached values of significance, the effect sizes at this lower academic level are considerably larger than the effect sizes found in the higher pre-university system (Table 2). Again, these results provide support for the role of junior elite sports in the self-reported use of self-regulatory skills, irrespective of academic system. This verifies existing theories proposing that the sporting environment may form a suitable environment for the development and use of self-regulation due to its goal-directedness and richness of feedback (Boekaerts & Corno, 2005; Pintrich & Zusho, 2002).

Given the fact that the scores of the pre-vocational elite youth athletes are similar to those of the pre-university non-athletes, and that elite youth athletes in the pre-vocational system even display higher levels of reflection (Table 1), our results further emphasize the relationship between junior elite sports and increased use of self-regulatory skills. That the pre-vocational elite youth athletes outscore their pre-university non-athletic peers specifically on reflection was not unexpected. Two recent studies have emphasized the importance of reflection in talent identification and talent development (Jonker et al., 2010; Toering et al., 2009). Reflection is referred to as a key characteristic in expert learning, enabling learners to change knowledge into action, which makes it possible for them to apply what they have learned in the past to new situations (Ertmer & Newby, 1996; Peltier et al., 2006). More specifically, the pre-vocational elite youth athletes are more involved in their learning processes and are trying to learn from past experiences to improve their future performances than their pre-university non-athletic counterparts are. As a consequence of the frequent use of reflective skills (i.e., mean scores above 4 on a 5-point Likert scale; Table 2), the elite youth athletes may profit more from the time they have spent in learning than non-athletes do (Ericsson, 2003; Jonker et al.; Toering et al.). Jonker and colleagues showed that the use of reflection may be particularly important at the highest levels of excellence in sports. We therefore recommend that future studies assess whether reflection may be a predictor for which elite youth athletes have the best potential to attain senior elite status.

Although our findings may suggest that involvement in junior elite sports may play a role in the development of self-regulation, it would be too ambitious to draw conclusions solely based on the result that elite youth athletes outscore non-athletes regardless of academic system, and that pre-vocational elite athletes are more reflective than pre-university non-athletes. While the sporting environment is rich in feedback and instruction and highly goal-directed, which can support the development of self-regulatory skills (Boekaerts & Corno, 2005; Pintrich & Zusho, 2002), it may also be the case that the elite youth athletes compete at these high competitive levels as a result of their frequent use of self-regulation, i.e., that they have an inborn ability to use their self-regulatory skills. We therefore suggest that future research examines this question of causality by using a longitudinal design or by intervention studies.

There are several limitations to this study. First, a self-report questionnaire was used which may be susceptible to socially desirable answers (Ericsson et al., 1993). Additionally, researchers also question the ability of individuals to report their cognitions accurately. However, the existence of valid self-report measurements has also been emphasized by others (Eccles, in press). With regard to the purpose of the present study, (i.e., to examine self-regulation in sport and academic performances of elite youth athletes), we consider the use of a questionnaire as most appropriate. Second, previous studies have shown that expertise in other domains such as music is also related to increased self-regulation (Nielsen, 2001). Although it would be interesting to assess the relationships between, for example, music, self-regulation and academic performance, we did not control for the role of other domains of expertise.

In conclusion

Our results show that elite youth athletes possess well-developed self-regulatory skills, especially reflection, and support the value of participation in junior elite sport. More specifically, within either the pre-university or pre-vocational system, elite youth athletes reflect more on their past performance in order to learn and are making more effort to accomplish their tasks successfully. Moreover, the elite youth athletes in the pre-vocational system outscored their pre-university non-athletic counterparts on their ability to learn efficiently by means of reflection. As a consequence, they may benefit more from the time they spend on learning. Given that the ratio of elite youth athletes in the pre-university system is relatively high, we suggest that the use of self-regulatory skills may help elite youth athletes to combine their extensive investments in sports with their educational purposes. It is, however, not yet clear whether these levels of self-regulation are a result of being active in sports or that elite youth athletes are people who were born with those skills. Nonetheless, our findings have some preliminary implications for people directly or indirectly involved with young athletes. Encouraging athletes to apply their self-regulatory skills both inside and outside their sports may help them to balance their sports and academic activities in a better way and also support their education.

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Chapter 5

Academic performance and self-regulatory skills in elite youth soccer players

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Abstract

Although elite athletes have been reported to be high academic achievers, many elite soccer players struggle with a stereotype of being low academic achievers. The purpose of this study was to compare the academic level (pre-university or pre-vocational) and self-regulatory skills (planning, self-monitoring, evaluation, reflection, effort, and self-efficacy) of elite youth soccer players aged 12–16 years (n = 128) with those of 164 age-matched controls (typical students). The results demonstrate that the elite youth soccer players are more often enrolled in the pre-university academic system, which means that they are high academic achievers, compared with the typical student. The elite players also report an increased use of self-regulatory skills, in particular self-monitoring, evaluation, reflection, and effort. In addition, control students in the pre-university system had more highly developed self-regulatory skills than those in the pre-vocational system, whereas no difference was observed within the soccer population. This suggests that the relatively stronger self-regulatory skills reported by the elite youth soccer players may be essential for performance at the highest levels of sport competition and in academia.

Keywords: *Metacognition, motivation, sports, education*

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Introduction

Students in The Netherlands can enter into one of two academic systems: the pre-university system, in which they are prepared for a university career, or the pre-vocational system, in which they are prepared for later vocational education. Academic success is based on the level at which students graduate and whether they have ever had to repeat class. In The Netherlands, repeating class occurs when students fail two or more relevant classes and have to repeat a complete year of study. Elite youth athletes tend to be relatively high academic achievers and are more often enrolled into the first of these two systems (Brettschneider, 1999; Jonker, Elferink-Gemser, & Visscher, 2009). They also have a higher graduation rate than students that are less engaged in sports (Watt & Moore, 2001). This

has been shown to be true for elite athletes in a variety of sports, including field hockey, volleyball, judo, and tennis.

However, despite these findings, soccer players continue to be perceived as below-average students (Kuper & Szymanski, 2009; Van Lieshout, 2002). This perception finds support in scientific literature, suggesting that many elite youth soccer players do not complete their formal educational programmes (Bourke, 2003). For decades, soccer has been one of the most popular sports across the world and it has recently grown into a multi-million pound labour market (Hoffmann, Ging, & Ramasamy, 2002; Lucifora & Simmons, 2003; Magee & Sugden, 2002). It has been proposed that elite youth soccer players may be more attracted to the high financial rewards and social status of being a professional soccer player than by the pursuit of an academic career (Bourke, 2003; Magee & Sugden, 2002). The stereotypical view that European youth soccer players are poor academic achievers is similar to that of student athletes in the United States in sports such as basketball and American football. The generally low academic performance of these athletes has received a great deal of negative attention in the media (e.g., Engstrom, Sedlacek, & McEwen, 1995; Umbach, Palmer, Kuh, & Hannah, 2006). The question remains whether elite youth soccer players are actually inferior to typical age-matched students in terms of their academic achievements, or if these perceptions are driven strictly by prevailing social stereotypes.

An interesting topic of study in the relationship between sport and academic performance of elite youth soccer players is related to the concept of self-regulation. Self-regulation is the degree to which learners are metacognitively, motivationally, and behaviourally proactive participants in their own learning process (Zimmerman, 1986, 1989, 2006). The metacognitive component is defined as the awareness of and knowledge about one's own thinking, and consists of several sub-components. These sub-components include planning, self-monitoring, evaluation, and reflection (Ertmer & Newby, 1996). The motivational component is defined as the extent to which learners are self-efficaciously, autonomously, and intrinsically motivated to attain a specific goal. Effort and self-efficacy are the sub components of motivation (Hong & O'Neil, 2001; Zimmerman, 1990a; Zimmerman & Martinez-Pons, 1990).

Elite youth soccer players are considered to be highly familiar with the cognitive construct of self-regulation (Cleary & Zimmerman, 2001; Kirschenbaum, 1984). This is partly because the standard at which soccer is played has risen dramatically in recent decades (Kuhn, 2005). It appears that expert performance not only depends on an athlete's physical training, but also on several other cognitive factors. Furthermore, the sporting environment is unique in that athletes can develop their self-regulatory skills by setting personal goals of attainment and improvement and by receiving continuous feedback from coaches on the performance process and on the action itself (Cleary, Zimmerman, & Keating, 2006; Jonker et al., 2009; Pintrich & Zusho, 2002). Previously, researchers have suggested that elite athletes are highly familiar with the need to self-regulate their own learning process and have emphasized the importance of self-regulation at these high standards of competition (Cleary & Zimmerman, 2001; Eccles & Feltovich, 2008; Kirschenbaum, 1984; Nota, Soresi, & Zimmerman, 2004). A recent study by Toering and colleagues (Toering, Elferink-Gemser, Jordet, & Visscher, 2009) showed that elite youth soccer players report using their self-regulatory skills more frequently than youth soccer players who are only involved in soccer as a leisure activity. The authors proposed that elite youth soccer players may gain greater benefits from training and competition because it affords them the opportunity to reflect more on their previous performances, allowing them to ultimately accomplish tasks with a greater degree of success.

Self-regulatory skills are suggested to be domain-general (Eccles & Feltovich, 2008; Kirschenbaum, 1984) and their importance has been emphasized in the academic setting as well. Literature suggests that the use of self-regulatory skills is predictive of an individual's academic standing, with respect to current level of education and instances of repeating class (Nota et al., 2004; Zimmerman, 1986, 2002). Thus, it may be considered an underlying characteristic of both sport and academic performance in youth elite athletes (Jonker et al., 2009). The assessment of the role of self-regulatory skills between the academic and sporting domains is therefore an interesting topic.

We examined the academic standing of elite youth soccer players and the role of their self-regulatory skills. We compared a group of elite youth soccer players with a representative sample of age-matched typical students in The Netherlands on academic level (pre-university or pre-vocational) and their self-reported use of self-regulatory skills (planning, self-monitoring, evaluation, reflection, effort, and self-efficacy). We wished to determine whether the elite youth soccer players achieved relatively better academic standards compared with the controls, dispelling any social myths, and if they reported using their self-regulatory skills more often, perhaps because of the high cognitive factors associated with today's brand of soccer. We hypothesized that the academic achievements of the elite youth soccer players would not be inferior to those of the typical students and that they would demonstrate an enhanced level of self-regulatory skills. To our knowledge, the role of self-regulatory skills in the interaction between competitive standard in soccer and academic standing has never been assessed.

Methods

Participants

A total of 292 male students aged 12–16 years participated in this study. Of these, 128 (mean age 13.9 years, s = 1.3) were part of a talent development programme at a professional soccer club and played at the highest competitive level in The Netherlands for their respective age group. All of these players are classified as elite youth soccer players because they are rated as being in the top 1% of all players in their age category (KNVB, 2007a, 2007b). Of the soccer players, 12.5% came from neighbourhoods defined as being of low socioeconomic status.

The remaining 164 participants (mean age 14.2 years, s = 1.3) were typical Dutch students and served as a control group. Of these, 116 (70.7%) were active in sports as a leisure activity, while 43 (26.2%) did not engage regularly in any sport-related activity. Five students (3.0%) in this group were classified as "elite youth" athletes in their respective sport because of their membership of a talent development programme in The

Table 1. Age, number of training hours per week, number of matches per week, sport experience (means ± standard deviations), academic level (*n* [%]) socioeconomic status (*n* [%]), and repeating class (*n* [%]) for the elite youth soccer players, the mainstream students and the population as a whole.

	Elite youth soccer players (*n* = 128)	Mainstream students (*n* = 164) [a]	Total (*n* = 292)
Age (years)	13.87 ± 1.32	14.17 ± 1.28	14.04 ± 1.30
Training (h/week)**	7.38 ± 1.95	2.29 ± 2.75	4.52 ± 3.50
Matches (h/week)**	1.85 ± 0.71	0.53 ± 0.84	1.10 ± 1.02
Sport experience (years)**	8.17 ± 1.93	7.01 ± 2.71	7.61 ± 2.41
Academic level**			
Pre-university (*n* [%])	87 (68.0)	76 (46.3)	163 (55.8)
Pre-vocational (*n* [%])	41 (32.0)	88 (53.7)	129 (44.2)
Socioeconomic status (SES)			
Low SES (*n* [%])	16 (12.5)	21 (12.8)	37 (12.7)
Middle or high SES (*n* [%])	112 (87.5)	143 (87.2)	255 (87.3)
Repeating class			
Never (*n* [%])	107 (83.6)	138 (84.1)	245 (83.9)
Once (or more often) (*n* [%])	21 (16.4)	26 (15.9)	47 (16.1)

Note. The national average of students at pre-university academic level is 43.0% and at pre-vocational academic level is 57.0% in the Netherlands (CBS, 2009). [a]121 students were engaged in sports, 43 were not engaged in sports. * $P < 0.05$. ** $P < 0.01$.

Netherlands (best 1% in their age category). The control group represents a typical Dutch student population in terms of the number that participate in sport (approximately 80%; Kamphuis & Van den Dool, 2008), proportionate representation in each of the educational systems (46.3% of students in pre-university education and 53.7% in pre-vocational education where the Dutch national average is 43.0% of students in pre-university education and 57.0% of students in pre-vocational education; CBS, 2009), and socioeconomic status (12.8% of students defined as having a low socioeconomic status where the national percentages defined 10.0–13.2% of the population as having a low socioeconomic status over a 5-year period; SCP, 2001, 2007). Table 1 shows the general characteristics of the two groups.

Instrument

To obtain the demographic details of the participants and to assess their involvement in sports and self-regulatory skills in a standardized manner, all participants completed a questionnaire designed specifically for the purpose of the study.

General questions

In the first part of the questionnaire, participants provided their date of birth and the four-digit zip code of their place of residence. These provided respective measures of age and socioeconomic status. This information was obtained because previous studies reported that differences in the use of self-regulatory skills exist between older and younger students (Al-Hilawani, 2003) and that socioeconomic status may be related to sport participation, self-regulation, and academic performance (Kamphuis et al., 2008; Nota et al., 2004; Sirin, 2005). In the present study, socioeconomic status refers to an aggregate standard of the household family income, education, occupation, and residential neighbourhood (Brooks-Gunn, Denner, & Klebanov, 1995). The four-digit zip code provided by the participants was compared with a list published by the Dutch Ministry of Housing, Spatial Planning and Environment (VROM) that specifies neighbourhoods low in socioeconomic status in The Netherlands. This list is based on four types of indicators: socioeconomic (income, employment, education), physical (small or old housing), social problems (vandalism, social inconvenience, unsafe), and physical problems (excessive noise, pollution, traffic, safety) (VROM, 2009). Since it is assumed that those families in The Netherlands with middle and high socioeconomic status have an equal opportunity to participate in sports and tend to have similar choices regarding the academic system, we decided to amalgamate these two strata and to use dichotomous ranking for socioeconomic status (low vs. middle to high socioeconomic status). Participants also noted the sport(s) in which they were involved, the number of hours spent training each week, the number of training sessions per week, and the number of years that they had been active in the sport(s). Data on whether participants were enrolled in the pre-university or pre-vocational educational systems were drawn from school databases. We decided to use current academic level as the standard for academic performance because in the Dutch educational system, graduation level (or future graduation level) is the most important determining factor of future career prospects (Education Inspectorate, 2008). As "strong" and "weak" students exist within each academic system, we also asked the participants to note whether they ever had to "repeat class", which means that they had to repeat a full academic year. In the present study, repeating class was a dichotomous variable and we simply asked the participants whether this happened or not.

Self-regulation items

All six aspects of self-regulation were assessed using the subscales of various existing questionnaires (see below). The subscales were translated from the original in accordance with the procedures described by Pelletier and colleagues (1995). First, two native Dutch speakers who were also proficient in English translated the original English subscales into Dutch. The Dutch translations were then re-translated back into English by two other bilingual individuals who had no prior knowledge of the original subscales. The resultant translations were evaluated by all translators and a Professor in Human Movement Sciences, which led to some minor linguistic modifications. This version was tested on forty-eight 11-to-14-year-old children, the youngest age band in our target group, who were asked to express what they thought was too difficult. Based on their comments we made some final linguistic modifications to increase the intelligibility of the items.

With respect to the reliability and va-

lidity of the questionnaire, we performed a confirmatory factor analysis among 1201 adolescents aged 11–17 years. The factor analysis supported the reliability and the construct validity of the instrument and showed satisfactory results for an adjusted six-factor model (presenting the details of the factor analysis was beyond the scope of this paper). Cronbach's alpha for the scales in the current study ranged from 0.72 for self-monitoring to 0.86 for effort. These alpha values are considered acceptable and are also in line with the original studies, where alpha ranged from 0.72 for evaluation and reflection to 0.85 for self-efficacy (Herl et al., 1999; Hong & O'Neil, 2001; Howard,McGee, Sia, & Hong, 2000; Peltier, Hay, & Drago, 2006).

Planning, self-monitoring, effort, and self-efficacy

The subscales for planning, self-monitoring, effort, and self-efficacy were originally formulated by Hong and O'Neil (2001) and Herl et al. (1999). All subscales consisted of 7–12 items and participants rated each item on a 4-point Likert scale that ranged from 1 (*almost never*) to 4 (*almost always*). High scores on these four self-regulation subscales indicated high metacognitive and motivational self-regulation in general task situations. The "planning" subscale was used to gauge the respondent's awareness of the task demands prior to its execution. An example of an item from this scale is "I determine how to solve a problem before I begin". The "self-monitoring" subscale evaluated the respondent's awareness of their actions during task execution. An example from this scale is "I keep track of my progress". The "effort" subscale measured the respondent's willingness to attain the task goal. An example from this scale is "I work as hard as possible on all tasks".

Self-efficacy, which is how the respondent judges his or her capability to organize and execute required actions, was assessed using the Generalized Self-Efficacy Scale. An example response on this scale would be: "No matter what comes my way, I am usually able to manage it" (Hong & O'Neil, 2001; Schwarzer & Jerusalem, 1995). While the authors are aware that domain-specific self-efficacy scales separately exist for sports and academics (Bandura, 1997), we used a general measure so as to remain consistent with the subscales used for self-regulation.

Evaluation

The 8-item Inventory of Metacognitive Self-Regulation (IMSR) subscale, developed by Howard and colleagues (2000), was used to examine evaluation. Evaluation is the ability of respondents to assess both the processes employed and the end product after task completion. An example question is "I go back and check my work". Participants responded to each item on a 5-point Likert scale that ranged from 1 (*never*) to 5 (*always*). A high score on the evaluation subscale indicated that the respondents often evaluated their performance.

Reflection

The 5-item Reflective Learning Continuum (RLC), developed by Peltier and colleagues (2006), was used to measure the extent to which respondents are able to appraise what they have learned and adapt their past knowledge and experiences to improve performance. An example question is "I often reappraise my experiences so I can learn from them". Because the items in the original subscale were written in past simple tense, we changed the subscale into present simple tense to maintain consistency with the other five subscales. Items were rated on a 5-point Likert-type scale ranging from 1 (*strongly agree*) to 5 (*strongly disagree*). Accordingly, low scores on the RLC indicated a high level of reflection. Scores were reversed for our analyses, such that high scores indicated a high level of reflection.

Procedure

All of the students were informed of the study's procedures prior to their participation and provided their verbal consent to participate. Informed consent was also obtained from the parents of the participants and the schools at which the participants attended. The control group of students and the group of elite youth soccer players were both randomly selected from the same schools. The questionnaire was implemented to all participants in a classroom setting during their regular school activities while in the presence of test leaders. The assessment took place in the period March–May, which is during the competitive soccer season. The procedures were in accordance with the standards of the local medical ethics committee at the lead institution.

Analyses

Descriptive statistics were calculated for both groups of students for academic standing and performance on the six subscales of self-regulation (planning, self- monitoring, evaluation, reflection, effort, and self-efficacy). To interpret the scores, effect sizes (*d*) were calculated. An effect size of approximately 0.20 was considered small, 0.50 moderate, and 0.80 large (Cohen, 1988).

A X^2-test was conducted to compare the elite youth soccer players with the control students on academic level (pre-university or pre-vocational). A multivariate analysis of covariance (MANCOVA) was used to examine differences in the six aspects of self-regulation for both study groups. The six aspects of self-regulation served as the dependent variables, whereas involvement in elite youth soccer (elite youth soccer players vs. control students) and academic level (pre-university vs. pre-vocational) were the independent variables. Since the self- regulatory skills may be related to repeating class, socioeconomic status, and age (Table 1), repeating class, socioeconomic status, and age were used as covariates. A univariate analysis of covariance (ANCOVA) was performed on each of the six aspects of self-regulation. An alpha of P = 0.05 was adopted for all tests of significance and the Bonferroni method was used to correct for multiple testing.

Results

The X^2-test revealed significant differences in academic level between the two groups [X^2 (1, N = 292) = 13.64, P < 0.001]. Specifically, a significantly higher percentage of elite youth soccer players were enrolled in the pre-university system (Table 1) than were control students. Table 2 presents the mean scores and standard deviations of self-regulation as well as corresponding effect sizes across performance levels and academic levels.

The MANCOVA (Table 3) revealed a significant main effect for involvement in elite youth soccer as well as a significant interaction between involvement in elite youth soccer and academic level (discussed below). No significant main effect was observed for

Table 2. Mean scores (± standard deviations) and effect sizes for all self-regulation subscales for the elite youth soccer players and the mainstream students streamed into the pre-university or pre-vocational level.

	Elite youth soccer players		Mainstream students	Elite youth soccer players				Mainstream students		
	(*n* = 128)	*d*	(*n* = 164)	Pre-uni (*n* = 87)	*d*	Pre-voc (*n* = 41)	*d*	Pre-uni (*n* = 76)	*d*	Pre-voc (*n* = 88)
Planning (Range 1-4)	2.55 ± 0.51	0.26⁺	2.42 ± 0.48	2.53 ± 0.51	-0.08⁺	2.57 ± 0.50	.28⁺	2.44 ± 0.43	0.08⁺	2.40 ± 0.51
Self-monitoring (Range 1-4)	2.57 ± 0.44	0.45º	2.36 ± 0.50	2.54 ± 0.43	-0.20⁺	2.63 ± 0.47	.29⁺	2.49 ± 0.48	0.49º	2.25 ± 0.50
Evaluation (Range 1-5)	3.46 ± 0.49	0.37º	3.25 ± 0.63	3.43 ± 0.49	-0.20⁺	3.53 ± 0.48	.28⁺	3.39 ± 0.53	0.43º	3.13 ± 0.68
Reflection (Range 1-5)	4.00 ± 0.69	0.48º	3.68 ± 0.63	3.99 ± 0.65	-0.06⁺	4.03 ± 0.78	.46º	3.71 ± 0.60	0.10⁺	3.65 ± 0.66
Effort (Range 1-4)	2.94 ± 0.46	0.73^	2.58 ± 0.53	2.91 ± 0.43	-0.24⁺	3.02 ± 0.50	.65^	2.69 ± 0.51	0.38º	2.49 ± 0.53
Self-efficacy (Range 1-4)	2.77 ± 0.38	0.17⁺	2.70 ± 0.44	2.7 8± 0.37	0.05⁺	2.76 ± 0.40	-0.10⁺	2.80 ± 0.43	0.44º	2.61 ± 0.44

Note. Pre-uni = pre-university level, pre-voc = pre-vocational level. *d* = 0.20 (small⁺), *d* = around 0.50 (moderateº), *d* = around 0.80 (large^).

Table 3. Results of MANCOVA for involvement in elite youth soccer, academic level and their interaction and for the covariates.

	Wilks' lambda	F	Hypothesis d.f.	Error d.f.	P
Involvement in elite youth soccer	0.836	9.138	6	280	0.000
Academic level	0.972	1.362	6	280	0.230
Involvement in elite youth soccer x academic level	0.948	2.546	6	280	0.020
Repeated class	0.971	1.410	6	280	0.211
Socioeconomic status	0.982	0.848	6	280	0.534
Age	0.901	5.121	6	280	0.000

players enrolled in the pre-vocational system had higher scores on effort than the students in the control group enrolled in the pre-university system (t_{127} = 3.80, P < 0.001, d = 0.65) (Table 2).

Involvement in elite youth soccer

A significant main effect for involvement in elite youth soccer was observed, such that the elite youth soccer players had higher scores than the control group on self-monitoring ($F_{1,285}$ = 14.51, P < 0.001), evaluation ($F_{1,285}$ = 9.323, P = 0.002), reflection ($F_{1,285}$ = 16.48, P < 0.001), and effort ($F_{1,285}$ = 35.49, P < 0.001), irrespective of academic level. Corresponding effect sizes varied from small-to-moderate on self-monitoring (d = 0.44) to moderate-to-large on reflection (d = 0.69; Table 2). No significant differences were observed for planning ($F_{1,285}$ = 4.52, P = 0.034, d = 0.26) or self-efficacy ($F_{1,285}$ = 1.39, P = 0.240, d = 0.17).

academic level. In addition, age was significant as a covariate (P < 0.001).

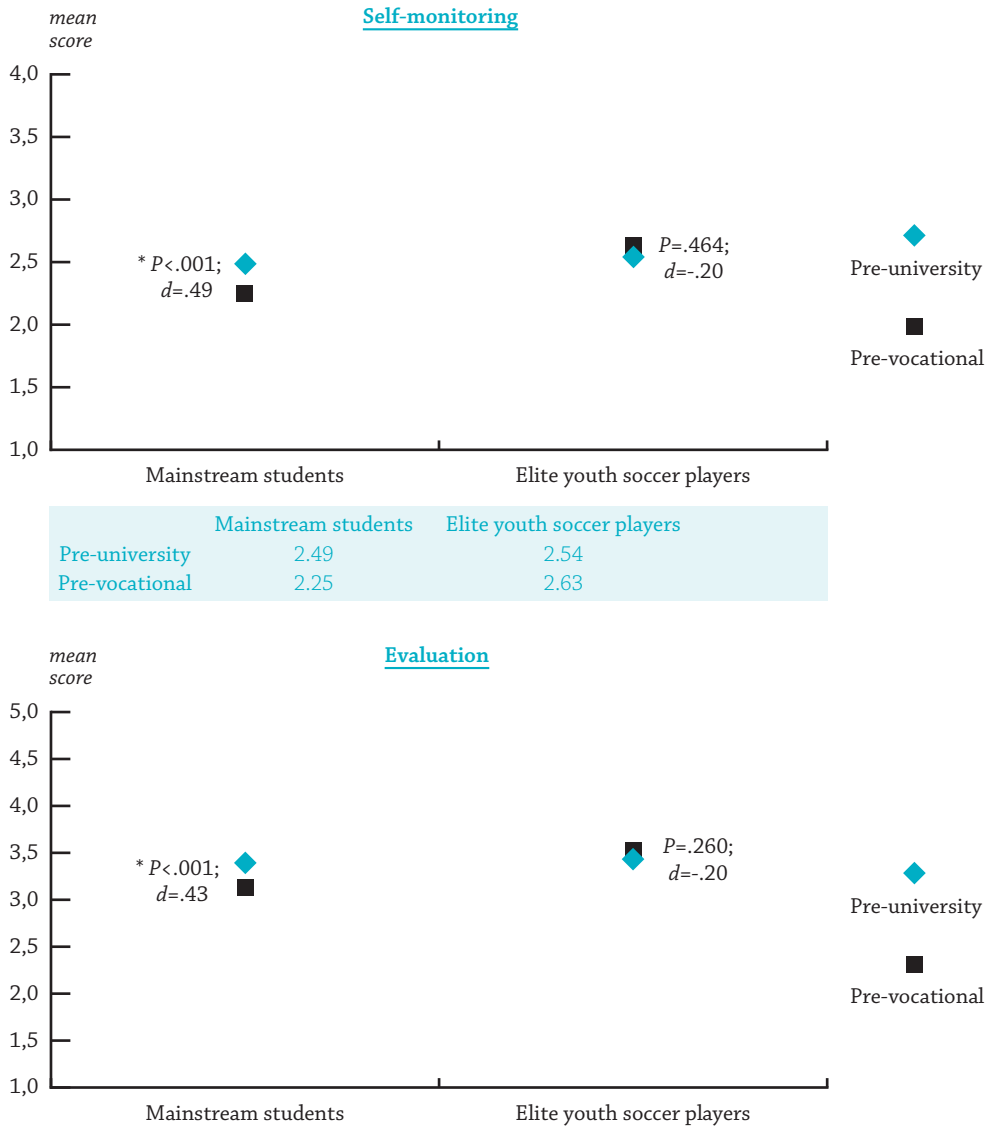
Interaction of involvement in elite youth soccer and academic level (Figure 1)

The univariate analyses showed a significant interaction between involvement in elite youth soccer and academic level for self-monitoring ($F_{1,285}$ = 7.78, P = 0.006), evaluation ($F_{1,285}$ = 7.09, P = 0.008), and effort ($F_{1,285}$ = 6.89, P = 0.009). Within the control population, the students in the pre-university system reported an increased use of self-monitoring (t_{179} = 3.96, P < 0.001, d = 0.49), evaluation (t_{179} = 3.89, P < 0.001, d = 0.43), and effort (t_{179} = 2.56, P = 0.011, d = 0.10) compared with those in the pre-vocational system. Within the elite soccer population, there was no significant effect of education on self-monitoring (t_{129} = 0.74, P = 0.464, d = –0.20), evaluation (t_{129} = 1.13, P = 0.260, d = –0.20), or effort (t_{129} = 1.38, P = 0.170, d = 0.24). In addition, the elite youth soccer

Discussion

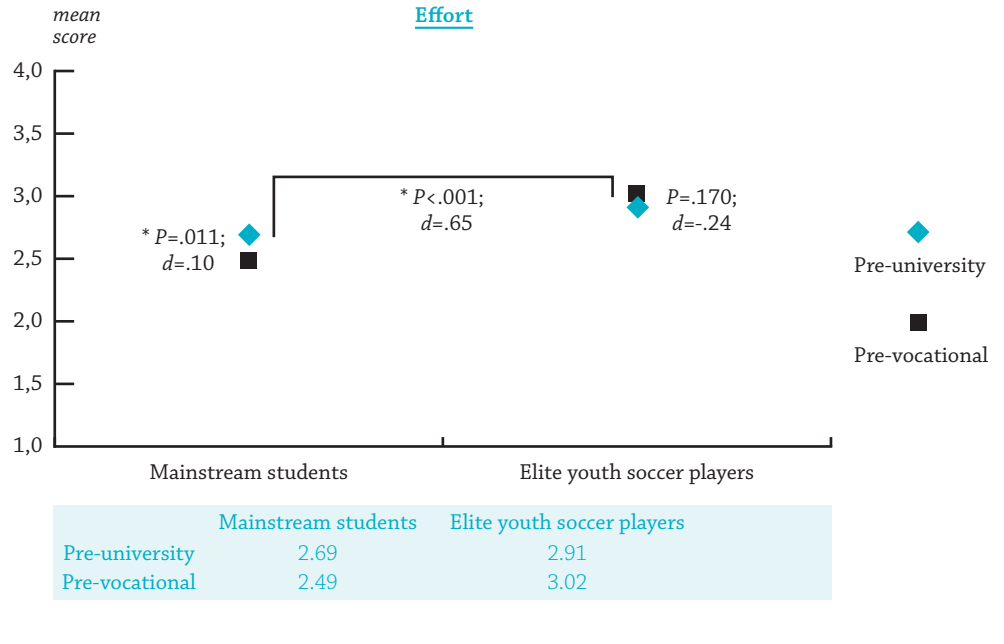
We compared enrolment into the pre-university and pre-vocational education systems for a group of elite youth soccer players and a group of typical student controls, both aged 12–16 years. We also compared the two groups' reported use of self-regulatory skills (planning, self-monitoring, evaluation, reflection, effort, and self-efficacy). Our results show that more of the elite youth soccer players are enrolled in the pre-university system than in the pre-vocational system (68.0% vs. 32.0%; Table 1), and that the opposite is true for the group of controls (46.3% vs.

Figure 1. Effect of interaction between involvement in elite youth soccer and academic level on self-monitoring, evaluation, and effort.



	Mainstream students	Elite youth soccer players
Pre-university	2.49	2.54
Pre-vocational	2.25	2.63

	Mainstream students	Elite youth soccer players
Pre-university	3.39	3.43
Pre-vocational	3.13	3.53



	Mainstream students	Elite youth soccer players
Pre-university	2.69	2.91
Pre-vocational	2.49	3.02

53.7%). This relatively high percentage of elite youth soccer players enrolled at the pre-university level is consistent with previous studies reporting that elite athletes are high academic achievers (Brettschneider, 1999; Jonker et al., 2009; Watt & Moore, 2001). We propose that elite youth soccer players are not performing poorly at school, but are actually performing better than the typical student. This is further demonstrated by the fact that the percentage of elite youth soccer players that had to repeat class was similar to that of the control students (Table 1). Participating in higher types of education is not accompanied by academic difficulty in the elite youth soccer player.

The question remains as to how these high academic standards are achieved by elite youth athletes. The answer may well be related to the standard of competition at which the players are competing. Elite soccer is a constantly changing environment in which players are required to make fast and accurate decisions (Kannekens, Elferink-Gemser, & Visscher, 2009). As a result, cognitive abilities are being developed. Furthermore, research has suggested that today's elite youth soccer players can only be successful by deliberately engaging in time-intensive training sessions aimed at performance enhancement (Ford, Ward, Hodges, & Williams, 2009; Ward, Hodges, Williams, & Starkes, 2007). The development of self-regulatory skills in this manner may benefit athletes academically, and perhaps reflects the high percentage of elite youth soccer players enrolled into pre-university education system.

That the soccer players scored higher on the self-monitoring, evaluation, reflection, and effort measures than the control students

is in general agreement with the self-regulation literature (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002). Regarding the role of self-regulation in the interaction between sport and academic achievement, our results show that within the control population, students in the pre-university system scored higher on self-monitoring, evaluation, and effort than students enrolled into the pre-vocational system (Ertmer & Newby, 1996; Zimmerman, 1990b). Within the elite soccer population, where all players are considered to have a relatively high sense of self-regulation (Toering et al., 2009), the difference between the students at the two educational levels was rather small (see small effect sizes in Table 2). Moreover, our results show that the elite youth soccer players in the pre-vocational system had significantly higher scores on effort than the mainstream students in the pre-university system (see moderate-to-large effect size in Table 2). Although not statistically significant, a similar pattern has been found for reflection, such that soccer players in the pre-vocational system report more frequent use of reflective skills than their pre-university mainstream peers (see moderate effect size in Table 2).

The results of the present study suggest that taking part in elite-level soccer may foster the development of self-regulation, independent of one's education. This is because self-regulation was more pronounced in the elite youth soccer players than it was in the control group students, and that the soccer players in the pre-vocational system had higher scores on effort than the control group of students enrolled in the pre-university system. However, caution is needed regarding this proposition, as it may also be the case that the elite youth soccer players are high achievers in sport and education because of an inherent ability to self-regulate. In other words, do the elite youth soccer players compete at a high level because their self-regulatory skills were developed through sport, or because these skills were inherent? Unfortunately, this question cannot be answered based on the current study. However, it is interesting to consider that, on the one hand, the elite youth soccer players are already experts in their age-category and consequently report more frequent use of their self- regulatory skills (than similarly aged typical students). On the other hand, they still need to improve their soccer skills to perform in senior elite soccer, in which the use of self-regulatory skills may serve them well (Ertmer & Newby, 1996; Toering et al., 2009).

The current study is not without its limitations. Since our aim was to investigate the self-regulatory skills of elite youth soccer players enrolled into the pre-university or pre-vocational education system, we decided to use a self-report instrument. Although self-report questionnaires are widely used in sport psychology research, results must always be interpreted with caution. Besides the fact that self-report questionnaires are generally sensitive to socially desirable answers (Young & Starkes, 2006), limitations occur in the ability for participants to accurately report their cognitions (Eccles, in press; Nisbett & Wilson, 1977). Nevertheless, other researchers have validated this form of assessment (Eccles, in press). For example, Nolen (1988) reported agreement of 70–96% between behavioural measures and self-report in the assessment of study strategies and motivational orientations in students.

Another shortcoming of the present study relates to the composition of the subgroups, as one could argue that the heterogeneity of the control (typical) sample may have interfered with the self-regulatory analyses. Specifically, it may have been a risk comparing a group that is known to have something in common (high level of performance in soccer) with a group that is considered not to have anything in common. Nevertheless, the samples are considered appropriate for the purpose of the present study, since our conclusions were based on the self-regulatory scores of the elite youth soccer players and the scores of the control group were only used as a reference.

The final limitation of the study relates to our cultural comparison. A similarity was drawn between European soccer players and American athletes (in revenue-producing sports) regarding the stereotype of being low academic achievers. However, the cultures in which the athletes are educated are quite different. In most European countries, including The Netherlands, top-level sports and education are two separate domains. The ultimate focus of the school is for student-athletes to graduate by realizing their highest academic potential (Metsä-Tokila, 2002; Stichting LOOT & Sardes, 2001). In the USA, sports and education are more intertwined and many schools offer scholarships to students simply because of their athletic ability. The focus of this culture is more on athletic performance and not on academia (Miller, 2003; National Collegiate Athletic Association, 2009; Yasser, 1993). It is not our intent here to debate the differences between or purposes of these two educational systems, but is to highlight the fact that these differences might influence how an athlete is motivated, performs, and uses self-regulatory skills in the academic environment.

In conclusion

Elite youth soccer players in The Netherlands are not academically inferior to their mainstream peers, but are actually better. Our results show that a higher percentage of elite youth soccer players are enrolled in pre-university level education. With respect to the role of their self-reported use of self-regulatory skills, our results show that elite youth soccer players in The Netherlands expressed a higher sense of self- regulation compared with the control group, irrespective of their level of education. Our results support previous research in that the frequent use of well-developed self-regulation skills may be essential for elite youth soccer players to compete at a high competitive standard (Toering et al., 2009) and to achieve academic success. It is, however, not yet clear whether the elite youth soccer players inherently possess these self-regulatory skills and used them from their early participation in soccer or if they are a result of their participation in high-level sport. This question of causality is an interesting avenue to investigate in future research. Nonetheless, our results have some preliminary implications for parents, teachers, trainers, and coaches of athletes and typical students. Supporting athletes and students to utilize their self-regulatory skills within and between performance domains may help them to balance their activities better and may also foster their achievements.

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Chapter 6

The development of self-regulatory skills in youth: The significance of sports and education

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Abstract

Self-regulatory skills (metacognitive and motivational) are associated with success in sports and academia and encompass an individual's capacity to control their learning process. We assessed the development of these skills in youth (aged 12-17 years) using multilevel modelling of longitudinal data. The effects of sport and academic data on this development were considered among 428 elite athletes, 140 regional athletes and 54 non-athletes. Athletes who trained more had higher self-regulatory scores with scores increasing over time (p<.05). A decrease was observed for effort. Reflection, evaluation, and effort were associated with competitive level, self-monitoring, evaluation and self-efficacy with academic level. The sport setting seems suitable for self-regulatory skill development as a strong association between training hours and these skills was observed.

Keywords: *Metacognition, motivation, talent development.*

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Introduction

The use of self-regulatory skills is often associated with success in domains such as sports (Anshel & Porter, 1996; Jonker, Elferink-Gemser, & Visscher, in press; Kitsantas & Zimmerman, 2002) and academics (Nota, Soresi, & Zimmerman, 2004). Nevertheless, many students between 12 and 16 years of age fail to self-regulate effectively (Boekaerts, 1997). Although there is considerable descriptive evidence for the value of self-regulation, it is not clear why some people are able to self-regulate while others are not. Recent studies in talent development in sports have shown that 12-to-16-year-old elite athletes use self-regulatory skills more frequently than their peers competing at lower competitive levels (Anshel & Porter, 1996; Jonker et al., in press). Interestingly, most elite athletes are also high academic achievers (Jonker, Elferink-Gemser, & Visscher, 2009) and it has been proposed that their increased use of self-regulatory skills may be an underlying mechanism for both their sport and academic achievements (Jonker et al., 2009). Nevertheless, it is unclear whether development of self-regulatory skills is more related to aspects of the sport and/or academic domains. Knowledge about this association will con-

tribute to existing developmental literature and may provide us with new leads regarding how to support children to develop and use self-regulatory skills.

Self-regulation in the context of learning and development encompasses the capacity of an individual to control his or her behavior. Zimmerman (1986, 1989) defined self-regulation as 'the degree to which learners are metacognitively, motivationally and behaviorally proactive participants in their own learning process' (p. 308, p. 329). In this definition, the metacognitive component relates to awareness of, and knowledge about, one's personal thoughts and feelings (Zimmerman, 1990). Skills such as planning (i.e., awareness of task demands prior to its execution), self-monitoring (i.e., awareness of actions during task execution), evaluation (i.e., ability to assess both the processes employed and the finished product after task completion), and reflection (i.e., ability to appraise what they has been learned and to adapt past knowledge and experiences to improve) are frequently mentioned metacognitive aspects (Ertmer & Newby, 1996; Hong & O'Neil Jr., 2001; Peltier, Hay, & Drago, 2006; Zimmerman, 1990). The motivational component refers to the degree to which learners are self-efficaciously, autonomously, and intrinsically motivated to attain a specific goal (Zimmerman, 1990) with effort (i.e., willingness to apply oneself to attain the set goal) and self-efficacy (i.e., judgement of capabilities to organize and execute the required actions successfully) as the critical elements (Hong & O'Neil Jr., 2001; Zimmerman, 1990). By the frequent use of self-regulatory skills, one may optimize the time spent on learning due to an improved ability to prioritize what has to be learned and how it must be learned (Toering, Elferink-Gemser, Jordet, & Visscher, 2009).

Previous studies suggest that metacognitive variables arise from as early as 4 to 6 years of age. Metacognition is expected to grow in the years thereafter (Alexander, Carr, & Schwanenflugel, 1995; McCabe, Cunnington, & Brooks-Gunn, 2004; Veenman & Spaans, 2005), although, it has been proposed that children are about 11 to 12 years of age when they are first able to actually use their metacognitive skills (Alexander et al., 1995). From this age on, their repertoire of metacognitive skills is expected to further develop and to merge from a set of domain specific skills to a more general repertoire that can be used across performance domains (Alexander et al., 1995; Van der Stel & Veenman, 2008; Veenman & Spaans, 2005). With respect to the motivational component, the age of 12 seems critical for the use of motivational skills as children after 12 years of age are better able to balance their efforts to succeed and to interpret their capabilities (Nicholls, 1978; Boekaerts, 1997).

Even though it has been assumed that self-regulatory skills start to develop at a very young age and increase thereafter (McCabe et al., 2004), they do not occur naturally (Boekaerts, 1997). Children are best able to develop self-regulatory skills in a powerful, inspiring and goal-oriented environment (Boekaerts, 1997), with youth sport proposed to be an optimal setting. To elaborate, elite athletes have to commit to sustained and effortful practice sessions (i.e., deliberate practice) for at least 10 years to improve and to meet the increasing demands of more advanced levels of competition (Boekaerts & Corno, 2005; Ericsson, Krampe, & Tesch-Römer, 1993). In line with deliberate practice theory, elite athletes are suggested to be self-conscious, goal-oriented and highly self-regulative to benefit optimally from the time

spend on training (Cleary & Zimmerman, 2001; Ericsson et al., 1993; Jonker et al., in press).

Moreover, in the sport domain athletes receive constant feedback about their performance, not just from the end result of their skill execution but also from trainers, parents and other participants. Goal-setting and appropriate feedback are suggested to help athletes to develop self-regulatory skills that assist them to positively modify their learning (Boekaerts & Corno, 2005; Pintrich & Zusho, 2002). With respect to competitive levels in sports, elite athletes have been found to use self-regulatory skills more often than athletes at lower competitive levels (Cleary & Zimmerman, 2001; Jonker et al., in press). This may be related to aspects of goal-setting and feedback as higher competitive levels are characterised by greater hours of training during which the level of goal-setting is assumed to be more sophisticated and the feedback received more specific.

Aspects of the academic domain have also been linked to the use of self-regulatory skills. More successful students (i.e., higher academic level), for example, outscore their less successful counterparts on self-regulatory skills (Nota et al., 2004). In The Netherlands, the level at which a student graduates (pre-university or pre-vocational academic level) is a commonly used marker for the use of self-regulatory skills and for academic success (The Netherlands Inspectorate of Education, 2008) Previous studies have shown that environments where students have high levels of control over their learning process are best to develop self-regulatory skills (Eshel & Kohavi, 2003). In the pre-university system, which takes 5 or 6 years to prepare students for a future university career, students are challenged to take responsibility for their own learning and to use their self-regulatory skills. The 4-year pre-vocational system, which prepares students for later vocational education, has a more supervising and competence-focused orientation (The Netherlands Inspectorate of Education, 2008). In addition, both academic systems have high and low achievers. When a student does not pass the relevant classes (i.e., Netherlands, English, mathematics) they have to repeat a full year of study.

Collectively, these studies emphasize the importance of self-regulatory skills in youth in the sport and academic domains. In sports, the environment may be unique for the development of these skills because of its goal-setting character and its richness of feedback (Hansen, Larson, & Dworkin, 2003; Pintrich & Zusho, 2002). In academics, successful students tend to be more self-regulative and different academic systems (or levels) have been related to different use of self-regulatory skills (Jonker et al., in press; Nota et al., 2004). Nevertheless, our understanding of the development and use of self-regulatory skills in youth is still limited. The purpose of the present study was to assess the development of six self-regulatory skills of 12-to-17-year-old youth similar in age, gender and socioeconomic status, but different in aspects related to the sport (competitive level and number of training hours) and academic domains (academic level and repeating class). We expected reflection and effort to be more related to sport outcomes based on previous studies that showed that these two self-regulatory skills best discriminated between elite athletes, regional athletes or non-athletes (Jonker et al., in press; Toering et al., 2009). Self-monitoring was expected to be most strongly linked to the academic domain as previous research reported that students at

higher academic levels used more complex self-monitoring than students at lower academic levels (Lan, 2005). Our longitudinal design may help to understand the development in the use of self-regulatory skills in 12-to-17-year-old youth and thereby support youth to use their self-regulatory skills within and between various performance domains.

Methods

Participants

During 2007-2010, 747 participants aged 12-17 years took part in a longitudinal study assessing their self-reported use of self-regulatory skills in general learning contexts. Measurements were taken on a yearly basis (i.e., every year in the period March-May), which resulted in 4 measurement occasions. Of this total of 747 participants, 622 were measured twice or more and were included in this study. 433 participants were tested on two occasions (866 measurements), 177 on three occasions (531 measurements), and 12 on all four occasions (48 measurements) which resulted in a total of 1445 measurements. The ages of the participants were registered in months to produce standardized age groups (i.e., a 15-year-old participant refers to someone between 14.50 and 15.49 years of age when tested).

Of the participants, 428 were designated as 'elite athletes' (303 male; 125 female) on the basis of their membership in a talent development program in The Netherlands. Membership in this program means they are considered to belong to be among best 2.5% of athletes in their age-category. The elite athletes were active in the 10 most popular sports in The Netherlands, spent approximately 9 hours per week on training (*M* = 8.73; *SD* = 4.57) and were active in their sports for approximately 8 years (*M* = 7.89;

Table 1. Means and standard deviations for number of training hours per week and years of sport experience, *n* and % for academic level, repeating class and gender for the number of measurements per age group subdivided by competitive level.

	n	Age		Sport training *		Academic level				Repeating class				Gender			
				(hours/week)		Pre-university		Pre-vocational		Never		Once		Male		Female	
		M	*SD*	*M*	*SD*	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Elite athletes																	
12-13 years	224	12.98	.36	8.10	4.49	176	78.6	48	21.4	207	92.4	17	7.6	167	74.6	57	25.4
14 years	279	14.03	.27	8.77	4.62	225	80.6	54	19.4	257	92.1	22	7.9	199	71.3	80	28.7
15 years	260	15.01^	.26	8.98	4.73	200	76.9	60	23.1	224	86.2	36	13.8	182	70.0	78	30.0
16 years	153	15.99	.28	8.90	4.31	123	80.4	30	19.6	128	83.7	25	16.3	104	68.0	49	32.0
17 years	69	16.96	.27	9.22	4.54	66	95.7	3	4.3	55	79.7	14	20.3	48	69.6	21	30.4
Regional athletes																	
12-13 years	38	12.96	.37	3.24	2.06	26	68.4	12	31.6	36	94.7	2	5.3	19	50.0	19	50.0
14 years	79	14.08^	.28	2.95	1.97	55	69.6	24	30.4	69	87.3	10	12.7	39	49.4	40	50.6
15 years	97	15.03	.29	3.10	1.80	69	71.1	28	28.9	83	85.6	14	14.4	45	46.4	52	53.6
16 years	82	16.01#	.27	3.52	2.78	54	65.9	28	34.1	62	75.6	20	24.4	40	48.8	42	51.2
17 years	38	17.01	.30	2.43^	1.20	27	71.1	11	28.9	20	52.6	18	47.4	15	39.5	23	60.5
Non-athletes																	
12-13 years	13	13.04	.40	0.00	.00	8	61.5	5	38.5	12	92.3	1	7.7	5	38.5	8	61.5
14 years	27	14.13	.29	0.00	.00	15	55.6	12	44.4	19	70.4	8	29.6	8	29.6	19	70.4
15 years	34	15.06	.30	0.00	.00	20	58.8	14	41.2	27	79.4	7	20.6	13	38.2	21	61.8
16 years	32	15.97	.29	0.00	.00	18	56.3	14	43.8	21	65.6	11	34.4	11	34.4	21	65.6
17 years	20	16.98	.30	0.00	.00	15	75.0	5	25.0	12	60.0	8	40.0	7	35.0	13	65.0

Note. ^ 1 missing value, # 2 missing values. * 68.8% of the elite youth athletes spent more than 6 hours per week on training (i.e., upper 2 training categories), 73.3% of the regional athletes spent less than 3 hours per week on training (i.e., lowest training category).

SD = 2.21). Among the elite athletes, 343 attended schools at the pre-university academic level and 85 at the pre-vocational academic level.

Of the participants who were not classified as elite athletes, 140 were categorized as regional athletes (67 male; 73 female) on the basis of their participation in organized and competitive sports in The Netherlands. This means that they competed in organized regional competitions on a weekly basis, but took part in sports primarily for fun and recreation. The regional athletes spent approximately 3 hours per week on training (*M* = 3.11; *SD* = 2.11) and had approximately 7 years (*M* = 6.81; *SD* = 2.80) experience in their sports. With respect to their academic levels, 97 regional athletes were involved in the pre-university system and 43 in the pre-vocational system.

Fifty-four participants (20 male, 34 female) did not participate in sports and were referred to as non-athletes. Of them, 34 were part of the pre-university system and 20 were part of the pre-vocational system. In Table 1, the general characteristics of the three competitive level subgroups are shown divided by age. All participants in the present study came from regular to high socioeconomic families.

The above mentioned 622 participants were included in a multilevel model assessing the use of self-regulatory skills longitudinally. The remaining 125 participants (from the initial 747 participants) were used to verify the appropriateness of the model. This group consisted of 50 elite athletes (*M* age = 14.49, *SD* = 1.39), 50 regional athletes (*M* age = 14.40, *SD* = 1.30) and 25 non-athletes (*M* age = 14.23, *SD* = 1.32) between 12 and 17 years of age. The elite athletes spent approximately 8 hours per week (*M* = 8.02, *SD* = 3.99) training and had been active in their sports for about 7.5 years (*M* = 7.54, *SD* = 2.26). The regional athletes trained approximately 3 hours per week (*M* = 2.80, *SD* = 1.65) and had about 8 years of experience in their sports (*M* = 8.27, *SD* = 2.54). The non-athletes were not active in sports. Ninety-six participants were part of the pre-university system and 29 of the pre-vocational system.

Instrument

The Self-Regulation of Learning Self-Report Scale (SRL–SRS; Toering, Elferink-Gemser, Jonker, van Heuvelen, & Visscher, in press) was used to measure the participants' personal details (i.e., date of birth and gender), aspects of their sport (i.e., the sport they participated in and the number of training hours per week) and academic (i.e., whether they ever had to repeat a class) experiences, as well as self-regulatory skills (i.e., planning, self-monitoring, evaluation, reflection, effort and self-efficacy). Planning (8 items), self-monitoring (6 items), effort (9 items) and self-efficacy (10 items) were scored on a 4-point Likert type scale ranging from 1 (*almost never*) to 4 (*almost always*). Evaluation (8 items) was scored on a 5-point Likert scale that ranged from 1 (*never*) to 5 (*always*). High scores on these subscales indicated more frequent use of these skills. The reflection subscale (5 items) ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). High scores on this subscale indicated a low level of reflection and was reverse scored in our analyses.

The SRS–SRL was reported to be reliable for adolescents between 11 and 17 years of age and its content and construct validity is supported (Toering et al., in press). The Cronbach's αs for the present study were considered sufficient and ranged between α = .78 and α = .86.

Procedure

All participants were informed about the procedures of the study and provided verbal consent. Informed consent for the study was also received from their parents and schools. The participants wrote their responses in a group setting in the presence of test leaders and were informed that the results would be used anonymously. All procedures were in accordance with the standards of the local medical ethics committee of the leading institution.

After completion of the questionnaire, training hours per week were evenly divided into four categories (i.e., category 0: ≤ 3 hours per week, category 1: > 3 hours per week, category 2: > 6 hours per week, category 4: > 9 hours per week). The database of The Netherlands Olympic Committee and Netherlands Sports Federation (NOC*NSF) was used to determine the competitive level of the athletes. The schools' databases were used to recruit whether athletes were involved in the pre-university or pre-vocational system.

Data analysis

To examine the longitudinal development of the use of self-regulatory skills for 12-to-17-year old youth, the multilevel modeling program MlwiN 2.02 was used (Rasbash, Browne, Goldstein, Yang, Plewis, Draper et al., 1999). Multilevel modeling is a regression analysis that is appropriate for hierarchically structured data. In our longitudinal data set, a two-level hierarchy was defined with the repeated measurements (level 1 units) grouped within the participants (level 2 units). In the multilevel model we chose to account for level 1 and 2 variance. As such, the model describes not only underlying population trends in each of the six self-regulatory skills (the fixed part of the model), but also models the variation around this mean response due to the time of measurement and individual differences (the random part of the model; Snijders & Bosker, 2000). The model properly accounts for correlations amongst repeated measurements within individuals (Peugh & Enders, 2005) and the advantage of using multilevel modeling is that it controls for differences in the number of measurements and the temporal spacing of the measurements between individuals (Landau & Everitt, 2004; Maas & Snijders, 2003; Peugh & Enders, 2005). The obtained results are valid as long as the missing data are random, which is the case in our study, since the missing observations did not relate to self-regulatory skills.

The procedure described in Snijders and Bosker (2000) was followed to determine the consecutive steps in our model. First, a satisfactory variance structure for each of the six self-regulatory skills in our dataset was established using age (measured in months and divided by 12). Based on previous theory, we first modeled the difference between elite athletes, regional athletes and non-athletes and the difference between training categories, taking the interaction with age into account. Subsequently, aspects related to the academic domain were modeled (i.e., academic level x age and repeating class). In the last step, the effect of gender was examined. During this step-forward method, significance of previous variables was constantly checked. Variables that were not significant were excluded from the model with the exception of age (our first step in the model and main question). By comparing the deviance of the empty model (i.e., model without predicting variables) and the subsequent models, the model fit was evaluated.

To test the appropriateness of our model, predicted scores were compared with actual scores of the control group using a paired samples *t*-test. An alpha of .05 was adopted for all tests of significance.

Results

Planning

In the development of planning skills significant differences were observed between the four training categories over time ($p < .05$). Athletes in higher training categories had higher scores on planning than their counterparts in lower training categories. All four training categories showed a similar developmental trend between 12 and 17 years of age (Figure 1).

By knowing an individual's age and training category (range 0-3 with the former being the lowest; Figure 1), the score on planning can be predicted with the following equation:

Planning = 2.327 + 0.002 (training category x age)

Self-monitoring
In the development of self-monitoring skills, significant differences were observed related to training categories x age, academic level x age and repeating class ($p < .05$). Not only were the differences in the scores on self-monitoring significant between the four training categories at all ages, the scores of the athletes in the upper two training categories increased significantly between 12 and 17 years of age ($p < .05$), whereas the scores of the lower two training categories were generally stable ($p > .05$).

With regard to academic level x age, the scores on self-monitoring of the pre-university youth were significantly higher than the pre-vocational youth at all ages ($p < .05$). In addition, the scores of the students in the pre-university system increased between 12 and 17 years of age, whereas the scores of the pre-vocational students remained stable between 12 and 16 years of age and decreased thereafter (Figure 2). Furthermore, students who had ever had to repeat class had lower scores on self-monitoring than their peers who did not repeat ($p < .05$).

Based on the multilevel model (Figure 2) and by knowing an individual's age, training category (range 0-3 with the former being the lowest), academic level (0 = pre-vocational, 1 = pre-university), and whether an individual has ever had to repeat class (0 = once and 1 = never), the scores on self-monitoring can be predicted:

Self-monitoring = 2.361 + 0.003 (training category x age) + 0.007 (academic level x age) + (0.103 x repeating class)

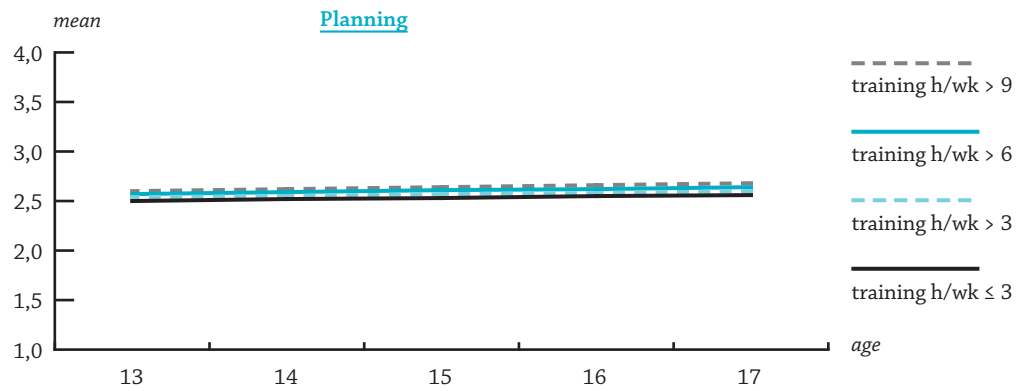
Evaluation
In the development of evaluation skills, significant differences related to competitive level x age and academic level x age were observed ($p < .05$). Not only were the scores on evaluation significantly different between the three competitive level subgroups, favoring athletes of higher competitive level ($p < .05$), the scores on evaluation of the elite athletes showed a slight increase between 12 and 17 years of age, whereas stability was observed in the other two subgroups (Figure 3).

With regard to academic level x age, the scores of the pre-university students were significantly higher than those of their pre-vocational peers at all ages ($p < .05$). In addition, the evaluation scores of the pre-university students showed a slight increase between 12 and 17 years of age, whereas the scores of the pre-vocational students decreased slightly (Figure 3).

Figure 3 shows that youth in the pre-university system outscored their peers in the pre-vocational system, irrespective of competitive level. Except for elite athletes at the pre-vocational level, they showed similar scores as the non-athletes in the pre-university system. Based on the multilevel model (Figure 3) and by knowing an individual's age, competitive level (0 = non-athlete, 1 = regional athlete, 2 = athletes) and academic level (0 = pre-vocational and 1 = pre-university), the scores on evaluation are predicted:

Evaluation = 3.340 + 0.004 (competitive level x age) + 0.009 (academic level x age)

Figure 1. Multilevel model and parameters for planning for the four training categories (1440 measurements).

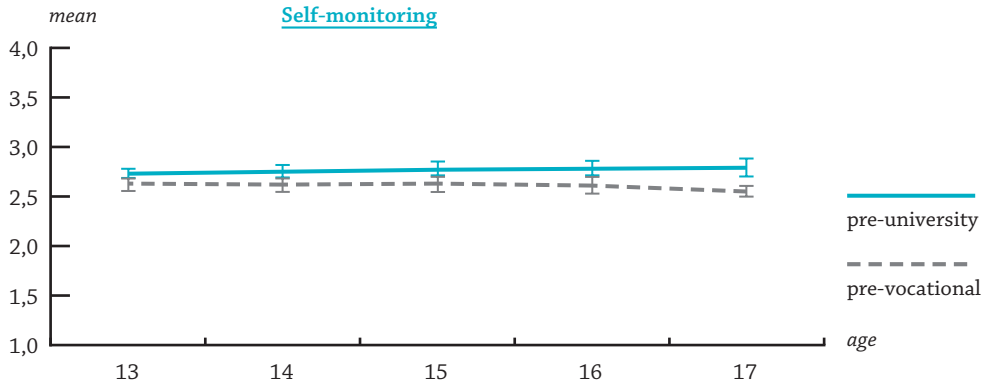


	age					*Standaard deviations*				
	13	14	15	16	17					
training h/wk ≤ 3	2.50	2.52	2.53	2.55	2.56	0.01	0.0	0.0	0.0	0.0
training h/wk > 3	2.54	2.55	2.57	2.58	2.60	0.01	0.0	0.0	0.0	0.0
training h/wk > 6	2.57	2.59	2.61	2.62	2.64	0.01	0.0	0.0	0.0	0.0
training h/wk > 9	2.60	2.62	2.64	2.66	2.68	0.01	0.01	0.01	0.01	0.01

Fixed effects	**Coefficient**	***S.E.***	***t*-value**	***df***	***p*-value**
Constant	2.327	0.162			
Age	0.014	0.011	1.273	1	.179
Age x training category (range 0-3)	0.002	0.001	2.000	3	.004*
Random effects					
Level 2 (between subjects)	0.130	0.012			
Level 1 (within subjects)	0.164	0.008			
Deviance	2122.828				
Deviance empty model	2137.772				

* $p < .05$

Figure 2. Multilevel model and parameters for self-monitoring, for pre-university and pre-vocational students, taking training categories and repeating class into account (1440 measurements).

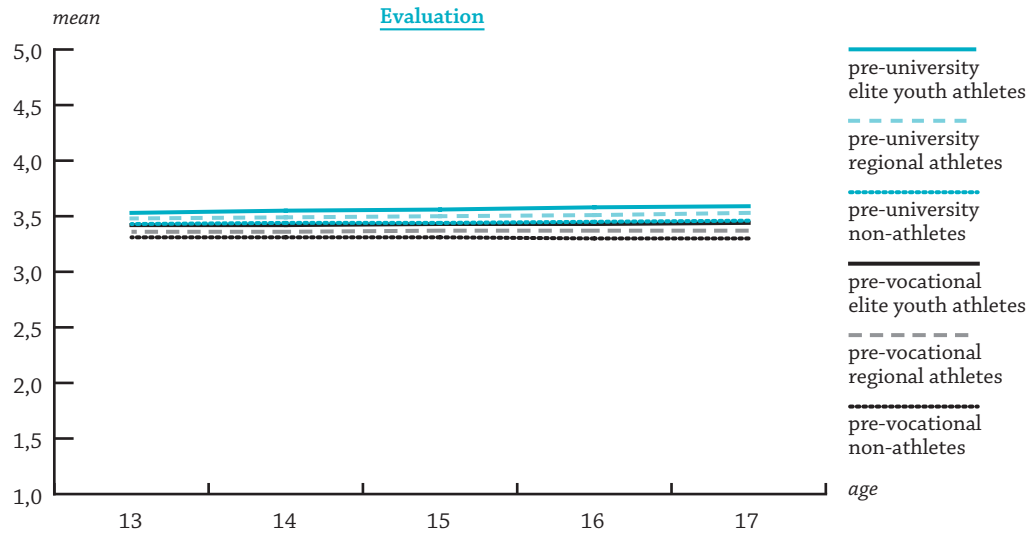


	age					Standaard deviations				
	13	14	15	16	17					
pre-university	2.73	2.75	2.77	2.78	2.79	0.05	0.06	0.07	0.07	0.09
pre-vocational	2.63	2.62	2.63	2.61	2.55	0.07	0.07	0.08	0.08	0.05

Fixed effects	Coefficient	*S.E.*	*t*-value	*df*	*p*-value
Constant	2.361	0.171			
Age	0.009	0.011	0.818	1	.202
Age x training category (range 0-3)	0.003	0.001	3.000	3	<.001*
Age x academic level (range 0-1)	0.007	0.003	2.333	1	.002*
Repeating class (range 0-1)	0.103	0.043	2.395	1	.017*
Random effects					
Level 2 (between subjects)	0.114	0.011			
Level 1 (within subjects)	0.157	0.008			
Deviance	2027.064				
Deviance empty model	2255.636				

* $p < .05$

Figure 3. Multilevel model and parameters for evaluation, for pre-university and pre-vocational students, elite athletes, regional athletes and non-athletes (1445 measurements).



	age					Standaard deviations				
	13	14	15	16	17					
pre-university elite youth athletes	3.53	3.55	3.56	3.58	3.59	0.01	0.0	0.0	0.0	0.0
pre-university regional athletes	3.48	3.49	3.5	3.51	3.53	0.0	0.0	0.0	0.0	0.0
pre-university non-athletes	3.43	3.44	3.44	3.45	3.46	0.0	0.0	0.0	0.0	0.0
pre-vocational elite youth athletes	3.42	3.42	3.43	3.43	3.44	0.0	0.0	0.0	0.0	0.0
pre-vocational regional athletes	3.36	3.36	3.37	3.37	3.37	0.0	0.0	0.0	0.0	0.0
pre-vocational non-athletes	3.31	3.31	3.31	3.3	3.3	0.0	0.0	0.0	0.0	0.0

Table belongs to Figure 3.

Fixed effects	Coefficient	*S.E.*	*t*-value	*df*	*p*-value
Constant	3.340	0.167			
Age	-0.002	0.012	-0.167	1	.390
Age x competitive level (range 0-3)	0.004	0.002	2.000	3	.011*
Age x academic level (range 0-1)	0.009	0.003	3.000	1	.001*
Random effects					
Level 2 (between subjects)	0.138	0.013			
Level 1 (within subjects)	0.170	0.008			
Deviance	2193.734				
Deviance empty model	2421.604				

* $p < .05$

Reflection

In the development of reflection skills significant differences were observed related to competitive level x age and training categories x age ($p < .05$). Not only were the scores on reflection of the elite athletes higher than those of the regional athletes and the non-athletes at all ages ($p < .05$), their scores also showed a slight increase between 12 and 17 years of age, whereas stability was observed in the other two subgroups (Figure 4). When compared to the scores on reflection of the non-athletes, the scores on reflection of the regional athletes were significantly higher at all ages as well ($p < .05$). A similar pattern was observed for the use of reflection for the regional athletes and the non-athletes ($p > .05$).

With regard to training category x age, significant differences between the four training categories were found at all ages (except between the two highest training categories at age 17). Athletes in higher training categories reported higher scores on reflection ($p < .05$). In addition, athletes in the upper three training categories slightly increased over the years, whereas athletes in the lowest training category slightly decreased ($p < .05$).

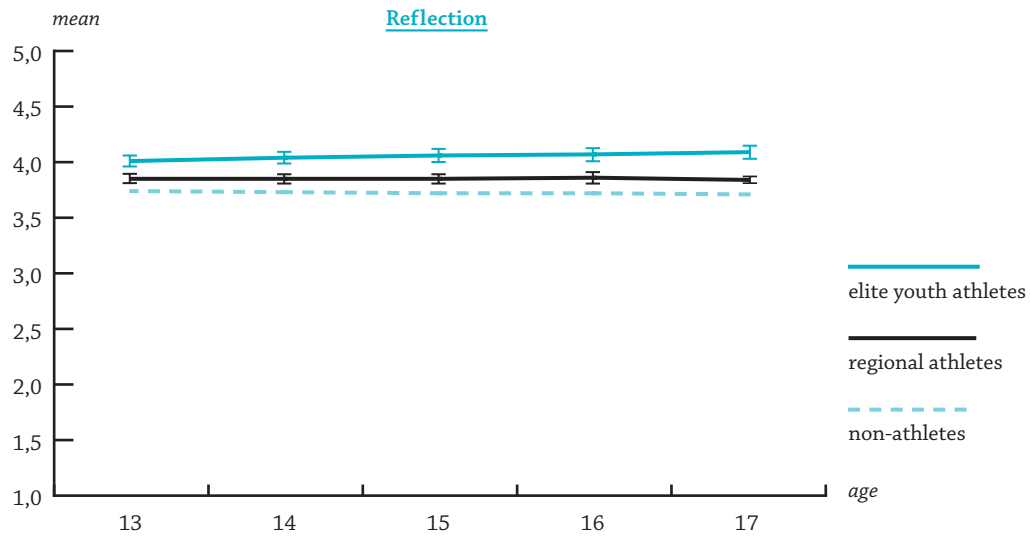
Figure 4 presents the model parameters. Based on this multilevel model and by knowing an individual's age, competitive level (0 = non athlete, 1 = regional athlete, 2 = elite athlete) and training category (range 0-3 with the former being the lowest), the score on reflection is predicted using the following equation:

Reflection = 3.823 + 0.007 (competitive level x age) + 0.004 (training category x age)

Effort

Effort was found to decrease significantly in the total population of youth between 12 and 17 years of age ($p < .05$; Figure 5); however, significant differences were observed related to competitive level x age, training category x age, and repeating class ($p < .05$). Not only were the scores on effort for the elite athletes

Figure 4. Multilevel model and parameters for reflection, for the elite athletes, regional athletes and non-athletes taking training categories into account (1440 measurements).

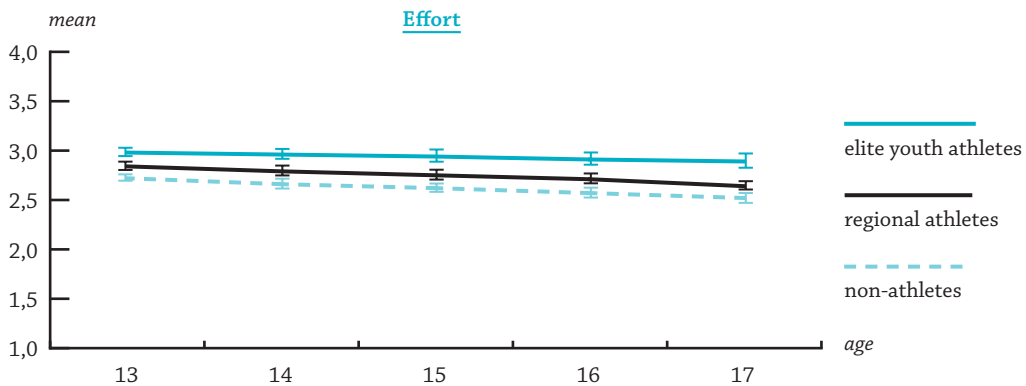


	age					*Standaard deviations*				
	13	14	15	16	17					
elite youth athletes	4.01	4.04	4.06	4.07	4.09	0.05	0.05	0.06	0.06	0.06
regional athletes	3.85	3.85	3.85	3.86	3.84	0.04	0.04	0.04	0.05	0.03
non-athletes	3.74	3.73	3.72	3.72	3.71	0.0	0.0	0.0	0.0	0.0

Fixed effects	Coefficient	*S.E.*	*t*-value	*df*	*p*-value
Constant	3.823	0.205			
Age	-0.007	0.014	-0.500	1	.909
Age x competitive level (range 0-2)	0.007	0.003	2.333	1	<.001*
Age x training category (range 0-3)	0.004	0.001	4.000	3	.002*
Random effects					
Level 2 (between subjects)	0.115	0.015			
Level 1 (within subjects)	0.301	0.015			
Deviance	2750.751				
Deviance empty model	2887.605				

* $p < .05$

Figure 5. Multilevel model and parameters for effort, for the elite athletes, regional athletes and non-athletes taking training categories and repeating class into account (1440 measurements).

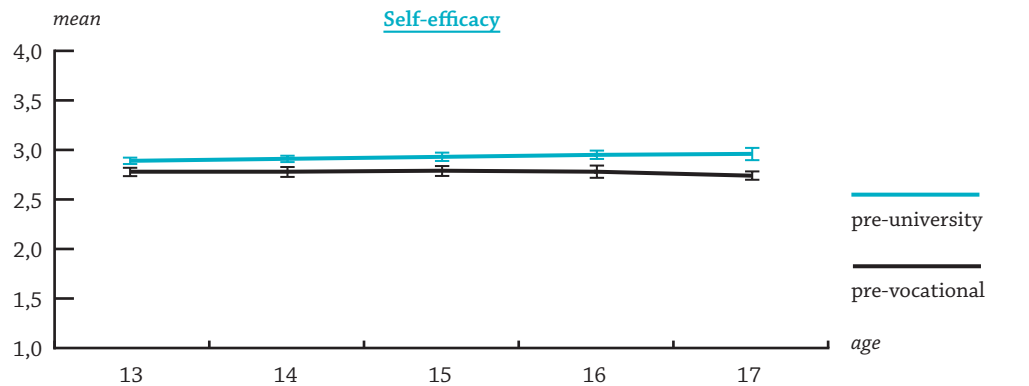


	age					*Standaard deviations*				
	13	14	15	16	17					
elite youth athletes	2.98	2.96	2.94	2.91	2.89	0.04	0.05	0.06	0.06	0.07
regional athletes	2.84	2.79	2.75	2.71	2.64	0.04	0.05	0.05	0.05	0.04
non-athletes	2.72	2.66	2.62	2.57	2.52	0.03	0.05	0.04	0.05	0.05

Fixed effects	Coefficient	*S.E.*	*t*-value	*df*	*p*-value
Constant	3.209	0.160			
Age	-0.044	0.010	-4.400	1	<.001*
Age x competitive level (range 0-2)	0.007	0.002	3.500	1	<.001*
Age x training category (range 0-3)	0.003	0.001	3.000	3	.008*
Repeating class	0.093	0.040	2.325	1	.022*
Random effects					
Level 2 (between subjects)	0.115	0.010			
Level 1 (within subjects)	0.133	0.007			
Deviance	1856.986				
Deviance empty model	2202.122				

* $p < .05$

Figure 6. Multilevel model and parameters for self-efficacy, for pre-university and pre-vocational students taking training categories and repeating class into account (1440 measurements).



	age					*Standaard deviations*				
	13	14	15	16	17					
pre-university	2.89	2.91	2.93	2.95	2.96	0.03	0.03	0.04	0.04	0.06
pre-vocational	2.78	2.78	2.79	2.78	2.74	0.04	0.05	0.05	0.06	0.04

Fixed effects	Coefficient	*S.E.*	*t*-value	*df*	*p*-value
Constant	2.496	0.145			
Age	0.013	0.009	1.444	1	.051
Age x training category (range 0-3)	0.002	0.001	2.000	3	<.001*
Age x academic level (range 0-1)	0.007	0.002	3.500	1	<.001*
Repeating class	0.083	0.036	2.306	1	.022*
Random effects					
Level 2 (between subjects)	0.081	0.008			
Level 1 (within subjects)	0.113	0.006			
Deviance	1547.773				
Deviance empty model	1779.308				

* $p < .05$

significantly higher than those of the regional athletes and the non-athletes at all ages ($p < .05$), their decrease was less steep over time ($p < .05$). The use of effort for the regional athletes and the non-athletes showed a generally similar decrease (except at age 17; Figure 5) with regional athletes having higher scores on effort at all ages ($p < .05$).

With regard to training category x age, athletes in the lowest two training categories showed a steeper decrease in effort over time compared to athletes in the upper two training categories ($p < .05$). The scores of the athletes in the lowest training category were significantly lower than the athletes in the second lowest training category ($p < .05$), but a similar developmental trend over the years was observed ($p > .05$). The upper two training categories showed a similar trend and no significant differences were observed in their scores on effort at all ages ($p > .05$). In addition, youth who never had to repeat class significantly outscored their peers who had to repeat class on self-reported effort ($p < .05$).

Based on the multilevel parameters (Figure 5), the scores on effort were predicted by knowing an individual's age, competitive level (0 = non athlete, 1 = regional athlete, 2 = elite athlete), training category (range 0-3 with the former being the lowest) and whether someone had ever repeated a class (0 = once and 1 = never):

Effort = 3.209 – (0.044 x age) + 0.007 (competitive level x age) + 0.003 (training category x age) + (0.093 x repeating class)

Self-efficacy

In the use of self-efficacy, significant differences were observed related to training categories x age, academic level x age and repeating class. Not only were the scores on self-efficacy of athletes in higher training categories significantly higher at all ages (except between the upper two training categories at age 14 and 17), the scores of the athletes in the upper two training categories showed a steeper increase between 12 and 17 years of age than those in the lower two training categories, which showed relatively similar scores.

With regard to academic level x age, scores of the pre-university students were significantly higher than those of their pre-vocational peers at all ages ($p < .05$). In addition, the scores of the pre-university students showed a significant increase between 12 and 17 years of age ($p < .05$), whereas the scores of the pre-vocational students showed a slight increase between 12 and 16 years of age and decreased thereafter (Figure 6). Additionally, students who had to repeat a class reported lower self-efficacy scores than their non-repeating peers ($p < .05$). No significant differences were observed for competitive level x age and gender ($p > .05$).

The multilevel model (Figure 6) can be used to predict the scores of individuals by knowing their age, their training category (range 0-3 with the former being the lowest), their academic level (0 = pre-vocational and 1 = pre-university), and whether someone had ever had to repeat class (0 = once, 1 = never). The equation was as follows:

Self-efficacy = 2.496 + 0.002 (training category) x age) + 0.007 (academic level x age) + (0.083 x repeating class)

Model fit

Table 2 shows the actual means (and standard deviations) and the predicted mean scores (and standard deviations) for the control group. The results of the paired samples *t*-tests revealed that the actual scores were not significantly different from the predicted mean scores for the six self-regulatory skills (Table 2).

Table 2. Observed and predicted mean scores on the six self-regulatory skills.

	Actual score		Predicted score		Difference			
	M	*SD*	*M*	*SD*		*t*-value	*df*	*p*-value
Planning	2.39	0.49	2.35	0.03	0.04	.833	124	.406
Self-monitoring	2.57	0.54	2.56	0.07	0.01	.273	124	.786
Evaluation	3.44	0.56	3.51	0.07	0.07	-1.343	124	.182
Reflection	3.92	0.50	3.99	0.12	0.07	-1.570	124	.119
Effort	2.73	0.51	2.81	0.13	0.08	-1.786	124	.077
Self-efficacy	2.72	0.36	2.67	0.06	0.05	1.774	124	.078

Discussion

The present study used longitudinal data to assess the development of six self-regulatory skills of 12-to-17-year-old youth and whether differences in development were related to aspects of the sport (competitive level and number of training hours) and academic (academic level and repeating class) domains. The control group showed an appropriate model fit which confirms the validity of these equations for 12-to-17-year-old youth.

Self-regulatory skills that were most related to the sport domain were reflection and effort. Elite athletes outscored their regional peers on these two self-regulatory skills at all ages. This is in line with a study of Toering and colleagues (2009) which showed cross-sectionally that 12-to-16-year old elite youth soccer players used reflection more often and were more willing to put forth effort than their regional peers. Our results extend this work by showing that elite athletes increased in their scores on reflection between 12 and 17 years of age and had less decrease in effort than the regional athletes and non-athletes in this age-period. Previous studies of talent development in sport have noted the importance of reflection with internationally competing athletes discriminating themselves from their peers competing nationally (Jonker, Elferink-Gemser, & Visscher, 2010). Reflection may be a key characteristic for learning among elite athletes, enabling them to comprehend knowledge and skills they have learned and to turn this knowledge and experience into action to improve future performances (Ertmer & Newby, 1996; Jonker et al., 2010; Peltier et al., 2006; Toering et al., 2009). Through the use of reflection, one can optimize time spent on learning which

may be necessary for realizing one's potential, particularly for developing high-performance athletes (Ericsson, 2003). Knowledge about how these skills develop in elite young athletes may assist those working with athletes (e.g., trainers and coaches) to help athletes develop reflection on their road to the top.

Previous research has also highlighted the importance of effort in elite sports; Anshel and Porter (1996) reported that elite athletes were more willing to practice regularly and with optimal effort and concentration than regional athletes. Ericsson and colleagues' deliberate practice theory (1993) emphasizes the need for developing experts to maintain optimal effort through their commitment to deliberate practice. These findings were extended by Ford and colleagues (Ford, Ward, Hodges, & Williams, 2009) who underlined the relationship between accumulated training hours during the talent years and the performance level reached by the senior athlete. Nevertheless, our results showed a decrease in effort, not only for non-athletes and regional athletes but also for the elite athletes between 12 and 17 years of age. This may be related to the increased capacity of children to differentiate between effort and ability between 12 and 17 years of age (Bandura, 1997; Multon, Brown, & Lent, 1991). It is possible that elite athletes carefully assess which tasks they put effort into instead of being effortful in all situations. It is of significant interest that the regional athletes in the present study outscored their non-athletic peers on reflection and effort as well. This phenomenon emphasizes the relevance of being involved in competitive sport as regional athletes may also benefit from their use of these two self-regulatory skills. Similarly, the association between sport and the development of self-regulatory skill is underlined by the significance of training categories x age for planning, self-monitoring, reflection, effort and self-efficacy. Athletes who spend more time training per week, irrespective of competitive level and academic aspects, seem to use their self-regulatory skills more frequently at all ages and show a steeper increase in their use over time. A flatter decrease for effort was observed among athletes who spent more time training. Involvement in competitive sport may familiarize athletes with the value of goal-setting and help them identify their strengths and weaknesses by means of feedback, thereby helping them learn to self-regulate (Boekaerts & Corno, 2005; Pintrich & Zusho, 2002).

Self-regulatory skills most associated with academics were evaluation, self-monitoring and self-efficacy. Even though evaluation was predicted by competitive level and academic level, students in the pre-university system generally reported an increased use of evaluation over their peers in the pre-vocational system, irrespective of competitive level. This is in line with previous research (Jonker et al., in press) showing that students in higher academic systems are more evaluative then students in lower academic systems. It should be acknowledged that the pre-vocational elite athletes served as an exception in the present study as they had similar scores on evaluation over the years as the pre-university non-athletes.

In line with our expectations, students in the pre-university system reported more frequent use of self-monitoring than students in the pre-vocational system and at all ages students who never had to repeat class outscored their counterparts that did. Lan (2005) reported that self-monitoring is a key self-regulatory skill in the academic domain as it activates and deactivates other self-regulatory aspects in the self-regulatory cycle of planning, self-monitoring and evaluation. With respect to self-efficacy, pre-university students and those who had never had to repeat class had increased scores on self-efficacy than their peers in the pre-vocational system and those who had to repeat class between the ages of 12 and 17. This is in line with previous research showing the relationship between perceived academic success (i.e., taking part in the pre-university system) and the negative effect of repeating class on students' self-efficacy and effort to learn (Välijärvi & Sahlberg, 2008). In the present study, those who had to repeat class had lower scores on effort as well.

This study has identified several intriguing findings regarding the development of self-regulatory skills but some limitations are worth noting. First, some might argue that training hours and competitive level are strongly related; our results, however, showed that both variables contribute to the development of self-regulatory skills. In addition, the correlation between these two variables in the present study was $r = .494$ which further supports the unique contribution of each of these elements. Second, our data were self-reported. Even though our instrument has shown sufficient reliability and validity (Toering et al., in press), the use of self-report is not without limits as some (Eccles, in press) question whether people are able to report their cognitions accurately. In the case of self-efficacy, the use of a general self-report measurement may have lead to less accurate responses (Bandura, 1997). The continued psychometric examination of this instrument is clearly important, however, using a general self-report instrument enabled us to follow and acquire information from large groups of participants and to relate their use of self-regulatory skills to aspects of the sport and academic domains. Third, our study design assumed that higher levels of achievement (whether this is in the sport or academic domain) were more facilitative to the development and use of self-regulatory skills, presumably due to an increased control over the learning processes by the individual. Differences in learning climate (learner vs. teacher control) may also exist between trainers working with athletes at similar competitive levels, within similar sports and between teachers within the pre-university as well as in the pre-vocational system. Yet, trainers who emphasized athletes' responsibility for learning and use of self-regulatory skills were most successful (van Ark, Elferink-Gemser, Roskam, & Visscher, 2010) and students with high levels of control over their learning process are generally more self-regulative and higher achievers (Eshel & Kohavi, 2003). We, therefore, recommend future intervention studies that focus on the development of the use of self-regulatory skills via supportive trainers or teachers who stimulate learners' to take control over their learning process. Moreover, the equations presented in this study may be helpful for evaluating the results of such interventions.

In conclusion

This study underscores the relationship between sports participation and the development of self-regulatory skills in youth between 12 and 17 years. Athletes who spend more time training per week showed an increased use of planning, self-monitoring

and reflection, were more willing to put forth effort, and displayed higher self-efficacy beliefs. For elite youth athletes striving to attain senior elite status, reflection and effort seemed most valuable with elite athletes outscoring their regional and non-athletic peers on these two variables and their scores increasing with age. Future studies should examine whether athletes with higher levels of reflection and effort are more likely to make it to elite status as an adult. Further, evaluation, self-monitoring and self-efficacy were more clearly associated with academic aspects. Greater attention to the development of self-regulatory skill through sport and educational experiences will not only inform our understanding of the development of exceptional athletes and students but will assist in the creation of more effective interventions to promote positive development in all youth.

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Chapter 7

Differences in self-regulatory skills among talented athletes: The significance of competitive level and type of sport

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Abstract

Research has shown that talented athletes outscore their mainstream peers on the basis of self-regulation. Although valuable, this does not tell us more about the distinction between good athletes and the best, which is a prerequisite in talent development. Therefore, we examined the self-regulatory skills of 222 male and female talented athletes aged 12–16 years as a function of competitive sport level (junior international or junior national athletes) and type of sport (individual or team sports). Multivariate analyses of covariance in combination with a discriminant function analysis revealed that "reflection" distinguishes between athletes at the highest levels of excellence. Furthermore, athletes playing individual sports had higher scores on "planning" and "effort" than team sport athletes, highlighting the importance of differences between types of sport. In conclusion, we emphasize the importance of reflection as a self-regulatory skill. Reflection facilitates the development of sport-specific characteristics, which may vary by type of sport. This means that an advanced sense of reflection may help talented athletes to acquire desirable characteristics during their "talent" years to ultimately reach adult elite levels of competition.

Keywords: *Metacognition, motivation, expert youth athletes, individual/team sports, talent development.*

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Introduction

Self-regulation is thought to be one of the key elements of successful learning (e.g., Clark & Ste-Marie, 2007; Van de Wiel, Szegedi, & Weggeman, 2004; Zimmerman, 2002a) as well as sport performance. Expert athletes distinguish themselves from their non-expert peers by their superior self-regulatory skills (e.g., Anshel & Porter, 1996; Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002). Furthermore, self-regulation has been related to effective time management, which may be especially relevant during the "talent" years (12–18 years in most sports), as this period is characterized by significant

investments of time in training to progress in sport in combination with an academic career (Brettschneider, 1999; Zimmerman & Martinez-Pons, 1986).

Even though a developmental paradox exists with respect to self-regulation (i.e., non-experts are associated with less knowledge and self-regulation, whereas the use of self-regulatory skills is related to increased knowledge and expertise; Pintrich & Zusho, 2002), it has been proposed that involvement in high-level sports may aid the development of self-regulatory skills. Self-regulatory literature suggests that before one can be self-regulated one must be "other-regulated". This means that self-regulatory skills are developed by instructions and feedback provided by others, such as coaches and teachers, which is largely the case in sports (Pintrich & Zusho, 2002). Furthermore, athletes involved in high-level sports are familiar with the need to be goal-directed and self-conscious to continuously improve their performances (Van de Wiel et al., 2004; Williams, Donovan, & Dodge, 2000). These characteristics are closely related to self-regulatory skills.

Self-regulation is the extent to which learners exert control over their own learning to master a specific task and to improve (Zimmerman, 1989, 2006). Self-regulated learners plan their performance in advance, monitor whether they are still on track during performance, and evaluate their performance outcomes afterwards. During these planning, monitoring, and evaluation cycles, self-regulated learners reflect constantly on their learning process, which enables them to use prior knowledge and strategies for future actions (Ertmer & Newby, 1996; Zimmerman, 2006). Besides knowing what aspects to improve, self-regulated learners must also be willing to engage in effective forms of self-regulation (i.e., they must be willing to put sustained effort in their performances) and they must believe that they have the potential to execute actions successfully (i.e., self-efficacy; Bandura, 1997; Ericsson, Krampe, & Tesch-Römer, 1993; Zimmerman, 2006).

For the purpose of this study, we adopted Zimmerman's (1986, 2006) definition in which self-regulation is the extent to which talented athletes are metacognitively, motivationally, and behaviourally proactive participants in their own learning process (Pintrich, 2000; Zimmerman, 1986, 2006). *Metacognition* is the awareness of, and knowledge about, one's own thinking and consists of planning, self-monitoring, evaluation, and reflection (Ertmer & Newby, 1996; Herl et al., 1999; Hong & O'Neil, 2001; Pintrich, 2000; Zimmerman, 1990, 2002b). *Motivation* refers to the degree to which learners are self-efficiously, autonomously, and intrinsically driven to attain their goals and consists of effort and self-efficacy (Hong & O'Neil Jr., 2001; Zimmerman, 1990).

Although the value of self-regulation in sports has been recognized in distinguishing experts from non-experts (e.g., Anshel & Porter, 1996; Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002), it does not help us to distinguish between good athletes and the best athletes. In the field of talent development, however, knowledge about what distinguishes the good from the best is essential. However, when all athletes are considered experts, any difference between them is not as clear as when they are compared with their less athletic counterparts. The few studies that have focused on psychological differences between athletes with "high" or "very high" competitive standard have reported minor differences (e.g., Elferink-Gemser, Visscher, & Lemmink, 2008; Elferink-Gemser, Visscher, Lemmink, & Mulder, 2007; Kannekens, Elferink-Gemser, & Visscher, 2009; Meyers, Bourgeois, LeUnes, & Murray; 1999; Orlick & Partington, 1988).

As various studies have indicated that differences in psychological skills exist between athletes playing individual sports (e.g., swimmers and judokas) and those playing team sports (e.g., field hockey and volleyball; Anshel, 1995; Helsen, Starkes, & Hodges, 1998; Highlen & Bennet, 1983), we also focused our investigation on possible differences between types of sports. Previous research has suggested that self-regulation is particularly relevant in individual sports in which the surroundings remain relatively stable during performance (Anshel, 1995; Elferink-Gemser et al., 2008; Highlen & Bennet, 1983), and in which many hours are spent in training and competition. According to Ericsson (1996, 2003; Ericsson et al., 1993), it takes at least 10,000 h of deliberate training, often over 10 years or more, to achieve expert performance (e.g., 8000–10,000 h in wrestling and figure skating; Starkes, Deakin, Allard, Hodges, & Hayes, 1996). In contrast, studies of team sport athletes have reported much less time in training to achieve expert status (e.g., 3000–4000 h in ice hockey, field hockey, netball, basketball, and soccer; Baker, Côté, & Abernethy, 2003; Helsen et al., 1998; Soberlak & Côté, 2003; Starkes, 2000). In addition, differences between athletes may also occur as a consequence of their age and gender. Older students tend to be more self-regulative than younger students (Al-Hilawani, 2003; Pintrich & Zusho, 2002; Zimmerman & Martinez-Pons, 1990). With respect to gender, there is inconsistency between studies (Anshel & Porter, 1996; De Jager & Reezigt, 1996; Zimmerman & Martinez-Pons, 1990).

The roles of the metacognitive and motivational skills of talented athletes, competing at the highest competitive levels in their age category, remain unclear. Therefore, the aim of the present study was to assess possible differences in self-regulatory skills within a group of highly talented athletes competing in either individual or team sports. Based on the above findings, we proposed that differences would be minor when comparing talented athletes at the highest levels of excellence (i.e., junior international or junior national level). Nevertheless, insight into the self-regulatory skills of these athletes may help them to develop desirable characteristics to achieve expert status.

Methods

Participants

A total of 222 male (n = 110) and female (n = 112) talented athletes aged 12–16 years, attending 21 schools in the Netherlands, participated in this study. All athletes were classified by the type of sport they competed in (i.e., individual sports, n = 113; or team sports, n = 109) and by their competitive standard (i.e., junior international level, n = 78; or junior national level, n = 144). Furthermore, all athletes attended classes at the pre-vocational [preparatory training for the International Standard Classification of Education (ISCED) levels 4 and 5] or pre-university level (preparatory training for ISCED level 6; Inspectie van het Onderwijs, 2008; UNESCO, 1997). Of the total population, 26.1% attended classes at a pre-vocational academic level and 73.9% attended pre-university classes.

Of the 113 athletes competing in indi-

vidual sports, 47 competed at junior international level (22 males and 25 females; mean age 14.3 years, *s* = 1.1). This means that in addition to their national commitments, they also trained and competed for the Netherlands internationally. Of these 47 athletes, 16 were gymnasts, 4 judokas, 10 speed skaters, 4 swimmers, and 13 tennis players. The other 66 athletes competed at junior national level (37 males and 29 females; mean age 14.0 years, *s* = 1.1) and included 5 gymnasts, 14 judokas, 19 speed skaters, 8 swimmers, and 20 tennis players.

Of the 109 athletes playing team sports, 31 competed at junior international level (14 males and 17 females; mean age 14.8 years, *s* = 1.1). This means that in addition to their involvement in national competitions, they also trained and competed to represent the Netherlands in international competition. Of these 31 athletes, 13 played baseball, 8 basketball, 3 field hockey, 3 handball, and 4 volleyball. The other 78 athletes competed at junior national level (37 males and 41 females; mean age 14.1 years, *s* = 1.0), 5 athletes of whom played baseball, 23 basketball, 9 field hockey, 24 handball, and 17 volleyball. All team sports in the present study are referred to as "interactive sports", in that the teams' performance outcomes are dependent on a combination of all individual players' performances (Landers & Lüschen, 2007). Table 1 shows the athletes' general characteristics.

Instrument

To obtain demographic details for the participants and to assess their involvement in sports as well as their self-regulatory skills, all participants completed a questionnaire specially compiled for this study.

General questions

In the general part of our inventory, participants provided their personal details (e.g., date of birth, gender, academic level) as well as the following sport-related data: sport competed in, number of training sessions per week, and number of training hours per week.

Table 1. General characteristics related to age, number of training sessions per week, total number of training hours per week (mean ± s), and academic level (*n* ± %) as a function of competitive level and type of sport.

	International			National		
	Individual (*n* = 47)	Team (*n* = 31)	Total (*n* = 78)	Individual (*n* = 66)	Team (*n* = 78)	Total (*n* = 144)
	mean ± *s*	mean ± *s*	mean ± *s*	mean ± *s*	mean ± *s*	mean ± *s*
Age (years)	14.3 ± 1.1[a]	14.8 ± 1.1[a]	14.5 ± 1.1[a]	14.0 ± 1.1[b]	14.1 ± 1.0[b]	14.0 ± 1.1[b]
Training (*N*/week)	7.19 ± 2.53[a]	5.35 ± 1.47[b]	6.46 ± 2.34[c]	5.71 ± 1.70[d]	5.26 ± 1.47[d]	5.46 ± 1.59[d]
Training (h/week)	19.24 ± 11.14[a]	11.79 ± 4.66[b]	16.28 ± 9.80[c]	11.20 ± 4.47[d]	9.68 ± 3.12[e]	10.38 ± 3.86[f]
Academic level	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Pre-vocational	10 (21.3)[a]	6 (19.4)[a]	16 (20.5)[a]	20 (30.3)[a]	22 (28.2)[a]	42 (29.2)[a]
Pre-university	37 (78.7)[a]	25 (80.6)[a]	62 (79.5)[a]	46 (69.7)[a]	56 (71.8)[a]	102 (70.8)[a]

Note. Within each row, means with the same superscript are not significantly different from each other at the .05 level.

Self-regulation items

The six self-regulatory skills were assessed using the subscales of various existing questionnaires (see below). These subscales were translated in accordance with the procedures described by Pelletier and colleagues (1995). First, two native speakers of Dutch proficient in English translated the original English subscales into Dutch, which were translated back into English by two other bilingual individuals who had no knowledge of the original subscales. The resultant translations were evaluated by all translators and their supervisor (Professor in Human Movement Sciences), which resulted in some minor modifications. Some additional but also minor modifications were made after we had tested the intelligibility of the questionnaire in a small sample of 11- to 14-year-olds, the youngest age band in our target group.

With respect to the reliability and validity of the questionnaire, we performed a confirmatory factor analysis with the data of 1201 adolescents aged 11–17 years. The factor analysis showed satisfactory results for an adjusted six-factor model, which also supported the construct validity of the instrument. Presenting the details of the factor analysis is beyond the scope of this study. However, we did calculate the internal consistency (Cronbach's alpha) for each group in the present study. Cronbach's alpha ranged from 0.74 for "self-monitoring" to 0.88 for "effort", which is considered acceptably high and in line with values reported in the original studies (i.e., range from 0.72 for "evaluation" and "reflection" to 0.85 for "self-efficacy"; Herl et al., 1999; Hong & O'Neil, 2001; Howard, McGee, Sia, & Hong, 2000; Peltier, Hay, & Drago, 2006).

Planning, self-monitoring, effort, and self-efficacy

The first three subscales were originally formulated by Hong and O'Neil (2001) and Herl et al. (1999). The "planning" scale gauges

the respondent's awareness of the demands of a task before its execution. The "self-monitoring" scale evaluates the awareness the respondent has of his or her actions during task execution, while the "effort" scale measures the respondent's willingness to apply himself or herself to attain the set goal. Self-efficacy (i.e., how the respondent judges his or her capabilities to organize and execute the required actions) was assessed using the Generalized Self-Efficacy Scale (Hong & O'Neil, 2001; Schwarzer, 1993; Wegner, Schwarzer, & Jerusalem, 1993). All scales consisted of 7–12 items and participants needed to rate each item on a 4-point Likert type scale ranging from "almost never" to "almost always". High scores on these subscales indicate a high level of metacognition and motivation in general task situations.

Evaluation

The 8-item Inventory of Metacognitive Self-Regulation (IMSR; Howard et al., 2000) was included to examine evaluation skills (i.e., the ability to assess both the processes employed and the end product after task completion). Participants responded to each item on a 5-point Likert-type scale ranging from "never" to "always". A high score on the "evaluation" scale indicates that the respondent often evaluates his or her performance.

Reflection

The five items of the Reflective Learning Continuum (RLC; Peltier et al., 2006) were selected to measure reflection (i.e., the extent to which respondents are able to appraise what they have learned and to adapt their past knowledge and experiences to improve themselves). Items are rated on a 5-point Likert-type scale ranging from "strongly agree" to "strongly disagree". Accordingly, low scores on the RLC indicate a high level of reflection, but we reversed the scores for our analyses. Thus, in the results, high scores on this subscale indicate a high level of reflection.

Procedures

All athletes, schools, and the athletes' parents were informed of the study's procedures, after which they provided their informed consent to participate. As all participants were attending schools with special provisions (e.g., flexibility in school timetable) within the regular Dutch education system, they completed the questionnaire in a classroom setting during their regular school activities. Test leaders were present and the assessment occurred within the competitive season (i.e., March–May). The procedures were in accordance with the standards of the local medical ethics committee of the University of Groningen, University Medical Center Groningen.

Data analyses

Analysis of the data was conducted using SPSS 14.0. For all six subscales of self-regulation (i.e., planning, self-monitoring, evaluation, reflection, effort, and self-efficacy), descriptives were presented according to competitive level (international vs. national level) and type of sport (individual vs. team sports). To interpret the scores, effect sizes (*d*) between competitive levels and types of sport were calculated. Effect sizes around 0.20 are considered small, around 0.50 moderate, and around 0.80 large (Cohen, 1988).

A multivariate analysis of covariance (MANCOVA) was used for analysis of the data. The scores on the six self-regulatory subscales served as the dependent variables and competitive level and type of sport as the independent variables. As self-regulatory skills may vary by age, gender, and academic level, these characteristics were considered as covariates. Where appropriate, univariate analyses of covariance (ANCOVA) for each of the six aspects of self-regulation separately, with competitive level and type of sport as factors, were conducted as follow-up tests. Again, age, gender and academic level served as covariates. A stepwise discriminant function analysis in which competitive level was the dependent variable was conducted to assess whether self-regulation could predict membership of the internationally competing or nationally competing groups. For all tests of significance, the Bonferroni method was used to correct for multiple testing and an alpha level of 0.05 was adopted.

Results

Mean scores and standard deviations on the six subscales of self-regulation by competitive level and type of sport and the corresponding effect sizes are presented in Table 2. The MANCOVA revealed significant differences for competitive level ($F_{6,210} = 2.224$; $P < 0.05$) and type of sport ($F_{6,210} = 2.236$; $P < 0.05$). No significant interaction was found between competitive level and type of sport ($F_{6,210} = 1.043$; $P > 0.05$). The covariates, age, gender, and academic level were also not significant (all $P > 0.05$).

The ANCOVA showed that, regardless of competitive level, athletes playing individual sports outscored their peers playing team sports on "planning" ($F_{1,215} = 5.387$; $P < 0.05$) and "effort" ($F_{1,215} = 5.715$; $P < 0.05$). No significant differences were found for "self-monitoring", "evaluation", "reflection", and "self-efficacy" (all $P > 0.05$). The effect sizes ranged from small for "self-monitoring" ($d = 0.24$), "evaluation" ($d = 0.00$), "reflection" ($d = 0.10$), and "self-efficacy" ($d = 0.16$) to small-to-moderate on "planning" ($d = 0.32$) and "effort" ($d = 0.29$).

With respect to competitive level, the results of the ANCOVA showed that, regardless of type of sport, athletes competing internationally had significantly higher scores on "reflection" ($F_{1,215} = 7.395$; $P < 0.05$) than athletes competing nationally. No significant differences were observed for the other five self-regulatory skills (all $P > 0.05$). Effect sizes were moderate for "reflection" and small on the other aspects of self-regulation (Table 2).

The MANCOVA was followed up by a stepwise discriminant function analysis to ascertain the nature of these results and their predictive value. This analysis showed that only "reflection" (Wilks' $\lambda = 0.960$; $F_{1,220} = 9.124$; $P < 0.05$) can discriminate successfully between athletes competing internationally and those competing nationally. The average squared canonical correlation was 0.200, which indicates that, knowing the scores on "reflection", the percent variance accounted for is 20%. Comparisons between the predicted group classifications and the actual group classifications can be made on the basis of the results of the discriminant function analysis. Table 3 shows that when competing internationally or nationally is predicted from "reflection", 58.1% of athletes are classified correctly.

Table 2. Mean scores, standard deviations (mean ± *s*), ranges and effect sizes (*d*) on all self-regulation subscales according to competitive level and type of sport.

	International competitive level						National competitive level		
	Individual (*n* = 47)		Team (*n* = 31)	Total (*n* = 78)		Total (*n* = 144)	Individual (*n* = 66)		Team (*n* = 78)
	mean ± *s*	*d*	mean ± *s*	mean ± *s*	*d*	mean ± *s*	mean ± *s*	*d*	mean ± *s*
Planning	2.92 ± 0.51[a] 2.00-3.89	0.47[o]	2.67 ± 0.55[b] 1.67-3.89	2.82 ± 0.54[c] 1.67-3.89	0.27[+]	2.68 ± 0.49[c] 1.56-3.78	2.74 ± 0.48[a] 1.78-3.78	0.18[+]	2.64 ± 0.50[b] 1.56-3.78
Self-monitoring	2.91 ±0.44[a] 2.13-3.63	0.41[o]	2.72 ± 0.48[a] 2.00-3.75	2.83 ± 0.46[a] 2.00-3.75	0.26[+]	2.71 ± 0.46[a] 1.38-3.88	2.73 ± 0.51[a] 1.38-3.88	0.06[+]	2.70 ± 0.42[a] 1.63-3.50
Evaluation	3.60 ± 0.50[a] 2.75-5.00	-0.06[+]	3.63 ± 0.51[a] 2.63-5.00	3.61 ± 0.50[a] 2.63-5.00	0.24[+]	3.49 ± 0.49[a] 2.00-5.00	3.49 ± 0.49[a] 2.00-4.75	0.00[+]	3.50 ± 0.50[a] 2.25-5.00
Reflection	4.14 ± 0.54[a] 2.40-5.00	-0.22[+°]	4.25 ± 0.45[a] 3.40-5.00	4.18 ± 0.51[a] 2.40-5.00	0.44[o]	3.90 ± 0.74[b] 1.20-5.00	3.84 ± 0.86[b] 1.20-5.00	-0.12[+]	3.95 ± 0.63[b] 1.40-5.00
Effort	3.18 ± 0.55[a] 2.00-4.00	0.50[o]	2.91 ± 0.52[b] 2.11-3.78	3.07 ± 0.55[c] 2.00-4.00	0.04[+]	3.05 ± 0.55[c] 1.67-4.00	3.11 ± 0.55[a] 1.67-4.00	0.22[+]	3.00 ± 0.54[b] 1.78-4.00
Self-efficacy	3.10 ± 0.42[a] 2.18-3.91	0.50[o]	2.87 ± 0.49[a] 1.64-3.73	3.01 ± 0.46[a] 1.64-3.91	0.23[+]	2.91 ± 0.40[a] 1.73-4.00	2.89 ± 0.43[a] 1.73-4.00	-0.10[+]	2.93 ± 0.37[a] 2.18-3.91

Note. *d* = around .20 (small+), *d* = around .50 (moderate[o]), *d* = around .80 (large^; Cohen, 1988). Within each row, means with the same superscript are not significantly different from each other at the 0.05 level.

Table 3. Classification of the stepwise discriminant function analysis (*n* and %).[a]

		Predicted group membership		
	Competitive level	International	National	Total
Original	International	*n* = 47 (60.3%)	*n* = 31 (39.7%)	*n* = 78 (100%)
	National	*n* = 62 (43.1%)	*n* = 82 (56.9%)	*n* = 144 (100%)

[a] 58,1% of original groupings correctly classified.

Discussion

The purpose of this study was to examine the self-regulatory skills of 12- to 16-year-old talented athletes as a function of their competitive level (junior international or junior national level) and type of sport (individual or team sports). Our results indicate that talented athletes competing at junior international level outscore their junior national peers on "reflection" and that this attribute is the only self-regulatory skill that successfully distinguishes athletes competing internationally from those competing nationally (Table 3). This finding extends previous research reporting that experts are more likely to self-reflect during athletic practice sessions than non-experts (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002).

The discriminant function analysis revealed that 58% of athletes were correctly classified, which means that classifying talented athletes on the basis of "reflection" adds 8% to classification based on chance (50%). We assume that this 8% is relevant, as we compared athletes towards the expert end of the learning continuum where differences appear minor. We are also aware that the 8% is based on a difference in mean score between the two study groups of 0.3 on a 5-point Likert scale. This appears minimal, but the practical meaning may be quite relevant.

When international athletes are compared with their national peers on "reflection", the standard deviations and range in scores (Table 2) of the internationals show less variation. All internationals possess an average-to-high extent of "reflection", as their lowest scores refer to the middle category (neutral) on the continuum of the Likert-scale (strongly agree–strongly disagree), whereas the scores of the nationals vary widely (i.e., between the lowest category and the highest category). In other words, to perform at international level, at least average amounts of "reflection" are essential. This is consistent with research stressing the importance of reflection in expert learning (Ertmer & Newby, 1996). Reflection helps the learner to comprehend knowledge and skills that have been acquired and to apply them in various situations (Peltier et al., 2006). Within the sports context, reflection facilitates the development of sport-specific characteristics that are important to realize one's full potential.

Although it has been proposed that involvement in high-level sports may aid the development of self-regulatory skills, circularity still exists in the role of reflection at the highest levels of excellence (i.e., at junior international and junior national levels). Are

international athletes competing at the highest level as a consequence of their well-developed sense of reflection, or are their highly reflective skills a result of their international expertise? Based on our data, we are unable to answer this question. In fact, our research population may be the middle of what the paradox is like. More specifically, the junior internationals are already experts in their age category, as they outperform their nationally competing peers in sporting terms as well as reflectively. However, to achieve senior international status, they still have to improve and reflection can assist to develop the required sport-specific characteristics efficiently (Ertmer & Newby, 1996). We therefore recommend using a longitudinal design to assess the development of self-regulatory skills in future studies.

Even though "reflection" was the only attribute that reached significance, the means of the other self-regulatory aspects were also higher for the athletes competing internationally. As anticipated, effort serves as the only exception. In this study, all athletes had relatively high average scores for "effort", surpassing 3.0 on a 4-point Likert scale. This is in line with Ericsson's deliberate practice theory (Ericsson, 2003; Ericsson et al., 1993). To reach senior international as well as senior national level, athletes need to invest many hours in training (at least 10,000 h over 10 years or more).

Not only may well-developed self-regulatory skills facilitate learning efficiency in sports, it may also help to combine the large time investments in sports with other activities such as academic study (Eccles & Feltovich, 2008). Regarding the academic achievements of the athletes, our results are consistent with previous research, suggesting an association between the level at which young athletes compete in sports and the level at which they study, namely that talented athletes frequently attend schools with pre-university academic level (Table 1; Jonker, Elferink-Gemser, & Visscher, 2009; Zimmerman & Martinez-Pons, 1986). This trend continues towards the higher competitive sport levels, since the percentage of internationals attending pre-university classes tends to be higher than that of nationals (approximately 80% vs. 71%; Table 1).

Regarding type of sport, athletes competing in individual sports had higher scores for "planning" and "effort". Based on these findings, we propose that athletes from different types of sport differ most on the self-regulatory skills that are strongly related to the sport-specific characteristics needed to perform well. More specifically, the environment in most individual sports remains relatively stable during training and competition, which makes it amenable to the use of planning strategies (Highlen & Bennet, 1983). In most team sports, however, skills are executed in a constantly changing environment, which makes the use of planning strategies less applicable (Elferink-Gemser et al., 2008; Highlen & Bennet, 1983). In addition, differences in self-regulatory skills between athletes from different types of sport tend to become more evident at international level (see effect sizes in Table 2).

That athletes playing individual sports are more effortful than their peers playing team sports can also be explained by sport-specific characteristics. Athletes competing in individual sports tend to spent more time in effortful and sustained training (Helsen et al., 1998; Starkes, 2000; Table 1). However, effort is not only expressed by the number of hours spent on training, but is also reliant on differences in the processes required for high-

level achievement. As a consequence of the individual character, athletes competing in individual sports are more affected by their own performance and less dependent on others for their performance outcomes (Elferink-Gemser et al., 2008; Régnier, Salmela, & Russell, 1993). Moreover, studies in individual sports have found a consistent correlation between level of excellence and the amount of solitary training (Ericsson, 2003). In interactive team sports, in contrast, athletes constantly have to act and react to behaviours of teammates and opponents. In addition, their personal achievements are less evident as they depend on a combination of various mini performances that contribute to the overall team performance valued by trainers and coaches (Elferink-Gemser et al., 2008; Kannekens et al., 2009; Landers & Lüschen, 2007; Régnier et al., 1993).

This study does have some limitations. As is common in self-regulatory studies, we used a self-report questionnaire that is generally sensitive to social desirable answers (Ericsson et al., 1993; Young & Starkes, 2006). Furthermore, this study involved several different sports. One might argue that it is relatively easier to become an international in one sport (e.g., bowling) than in another sport (e.g., tennis) simply due to differences in the number of athletes playing the sport. However, this phenomenon is considered of secondary relevance, as all the sports included were popular sports in the Netherlands (i.e., top-20 sports, except baseball), accounting for more than 35% of Dutch athletes (NOC*NSF, 2008). Another issue is the heterogeneity within the group of internationals, as it may well be the case that internationals differ in the number of minutes that they are active during competition. Nevertheless, the distinction between athletes competing internationally or nationally is considered relevant as all internationals train and compete to represent the Netherlands in addition to their commitments at national level, whereas the nationals do not. To further unravel the mystery of expertise, we recommend assessing the self-regulatory skills of athletes who are most successful in sports (e.g., by winning medals at the highest competitive level). However, the numbers of athletes competing at this level is limited.

In conclusion

Our results show that athletes competing in individual sports outperform their team sport peers on "planning" and "effort" at the highest levels of junior competition and that athletes competing internationally can be distinguished from athletes playing nationally on the basis of their reflective skills. Athletes competing internationally reflect more on their learning process and on past performances, which implies that they learn more efficiently than their national peers. It is not clear, however, whether they are junior internationals as a consequence of their well-developed sense of reflection, or whether their highly reflective skill is a result of their international expertise. Nonetheless, learning efficiently by means of reflection may be considered a key process in the development of junior international athletes and may help in achieving senior international status.

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Chapter 8

The role of reflection in sport expertise

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Abstract

Reflection is considered a key factor in expert learning and refers to the extent to which individuals are able to appraise what they have learned and to integrate these experiences into future actions, thereby maximizing performance improvements. We assessed the relation between self-reported reflection at baseline and attainment (i.e., international vs. national level) 2.5 years later in 52 elite youth athletes. A Mann-Whitney *U* test showed that those who became senior internationals scored highest on reflection during their junior years compared to those who only attained senior national status. More specifically, athletes who made the transition from junior national to senior international level had higher reflection scores than their peers who did not reach international status and had similar scores to those who were internationals already. These results emphasize the value of reflection in elite youth athletes to attaining senior international status later in development.

Keywords: *Sport psychology, adolescent, coaching, teaching, training*

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Introduction

In recent decades, increased research attention has been paid to unraveling what it takes for athletes to compete at the highest level, particularly the factors explaining the process of skill acquisition from novice to expert. There is, for example, a long history of interest in the link between practice and attainment (Côté, Baker, & Abernethy, 2007 for a review). Central to this discussion is Ericsson and colleagues' (1993) theory of deliberate practice, which is grounded in the notion that athletes (and other experts) must perform sustained and effortful practice sessions for many years. Elite youth athletes need to progress through different developmental stages in their road to the top with the primary goal of improving current performance levels (Ericsson, Krampe, & Tesch-Römer, 1993). Several studies have emphasized the relationship between the number of training hours of an athlete and the performance level ultimately reached (e.g., Falk, Lidor, Lander, & Lang, 2004; Ford, Ward, Hodges, & Williams, 2009; Helsen, Starkes, & Hodges, 1998; Hodges & Starkes, 1996; Starkes, Deakin, Allard, Hodges, & Hayes, 1996).

Although relevant, with increasing practice and autonomous performance control, athletes who keep progressing need to counteract automaticity and remain cognitively engaged in order to improve (Ericsson, 2003). Recent research in talent development has underlined the value of cognition by showing that athletes who competed among the best 1.0% in junior competitions (i.e., junior international level) discriminated themselves from their peers competing nationally (i.e., the best 2.5%) by their increased use of reflection (Jonker, Elferink-Gemser, & Visscher, 2010). Reflection is defined as an individual's capacity to apply prior experiences in order to improve subsequent performances in a goal-directed and effective manner (Mezirow, 1991; Peltier, Hay, & Drago, 2006; Zimmerman, 2000). It seems that reflection plays an important role during phases of development, but it remains unclear whether increased use of reflection may play a part in the attainment of senior elite status. Therefore, the purpose of the present study was to relate levels of reflection in elite youth athletes 2.5 years before their age-related transition to attainment at the senior level in order to evaluate the role of reflection in talent development.

Reflection in the context of learning and performance is not a new phenomenon. From an educational perspective, Dewey (1933) reasoned that reflection (i.e., 'the active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends'; Dewey, 1933, p. 9) facilitates the problem solving process and improves the effectiveness of learning. More recently, interest in reflection has increased through the work of Zimmerman (1986) and Mezirow (1991) among others.

Zimmerman (1986, 2000) considered reflection as the last phase (self-reflection phase) in his self-regulated learning theory. Self-regulated learners are defined as 'metacognitively, motivationally and behaviorally active participants in their own learning process' (Zimmerman, 1986, p. 308). Reflection is considered to be the part of metacognition that refers to awareness of and knowledge about one's thinking and learning. According to Zimmerman (2000) learners can self-reflect to the result (self-judgement) or to a standard or goal (self-reaction). Differences in these types of reflective thinking are related to learners' sub processes of self-evaluation, causal attributions (as part of self-judgement), self-satisfaction and adaptive inferences (as part of self-reaction). Though Zimmerman's initial work was conducted in an educational setting, his theory has been applied in sports as well (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002). This means that athletes who want to improve compare self-observed performance against obtained improvement, prior performance, performance of others or contribution to the team performance (i.e., self-evaluation), relate their causes of success and failure to the self-observed performance (i.e., causal attributions), feel satisfied or dissatisfied during reflection by their performance (i.e., self-satisfaction), and adapt their behaviour and decisions accordingly to implement new or potentially better strategies and forms of performance regulation to improve in the future (i.e., adaptive inferences; Zimmerman, 2000). As Zimmerman's view of self-regulation is cyclical, these reflective processes take place after each learning effort and have an influence on the subsequent forethought and performance phases of new

learning (Zimmerman, 2008). In sports, Cleary and Zimmerman (2001) showed that expert athletes selected more specific goals to reach based on reflective thinking, used more technically oriented strategies and were better able to relate their successes and failures meaningfully by using more strategy attributions.

Within an educational setting, Mezirow (1991) considered critical reflection as an important characteristic of metacognitive reasoning as well. It shapes learners thereby affecting subsequent learning experiences (Mezirow, 1991, 2003). According to Mezirow (1991), reflective people are aware of their kind of reasoning, their way of reasoning and why they need to reason. In addition, they are conscious about previous learning experiences and are eager to challenge established behavioural patterns and meaning perspectives in their problem solving efforts. They look for new ways to reorient their problem-solving behaviour in a more effective way. Through reflection, people in general are able to understand themselves and their learning processes better.

In the present study, we used the initial theories of Zimmerman (1986, 2000) and Mezirow (1991) and considered reflection as the ability of individuals to a) critically value their learning processes by looking back on previous performances which includes Zimmerman's (2000) sub processes of self-evaluation and causal attribution and b) use new information in subsequent learning situations to improve which includes Zimmerman's (2000) sub processes of adaptive inference. In a practical sense the following two events are examples of the athletes' use of reflection. Soccer player X is selected for the under 19 international youth selection (i.e., junior international level in the year before transition) based on his current capacities. He is tall, strong, and has a good kick, but is less technical and fast. He knows that he has to score more goals if he wants to become selected for the 'real' Dutch soccer team next year. Based on his capacities (i.e., tall, strong, good kick) he decides that his chances to score more goals are biggest when he starts practicing on his free kick. From now on, he arrives early at training to practice and stays after training to refine his kick. At home, he keeps on training his accuracy. Furthermore, he monitors whether this strategy results in attainment of his goal: score more goals during games to become selected for the Dutch soccer team (Toering, 2011, pp. 15). Another example is related to speed-skater Y who has become European champion allround speedskating (i.e., best over 4 distances including 500m, 1000m, 1500m and 10.000m). Though, to become an Olympic medalist, which he thinks is the highest achievable, he decides to specialize and solely focus on the 1000 and 1500 meters as he assumes to have the most chance at these distances. Therefore, he starts training on speeding-up his opening and the first full round as he is convinced that this will be most beneficial. To develop more speed, he needs to adapt his technique and therefore decides to ask advice from a second coach who is specialized in training sprinters' technique. Several researchers' have cited that expert learners (such as soccer player X and speed skater Y) are more strategic than non-experts or novices (e.g., Cleary & Zimmerman, 2001; Ertmer & Newby, 1996; Kitsantas & Zimmerman, 2002; Jonker et al., 2010; Toering, Elferink-Gemser, Jordet, & Visscher., 2009) and we consider reflection to help individuals to improve by reflecting on task specific performance characteristics such as mentioned in the examples above.

Elite youth athletes striving to reach the top need to improve multiple sport specific performance characteristics (e.g., psychological, technical, tactical) to become good enough for senior international level (Elferink-Gemser, Jordet, Coelho-E-Silva, & Visscher, 2011). In this case, it is assumed that highly reflective elite youth athletes may improve these skills faster and may thereby perform better at a later age as they approach their learning more efficiently by means of reflection. The value of reflective thinking related to performance improvement has been established in human resource development (Van Woerkom, 2004; Van Woerkom & Croon, 2008), and academics (Phan, 2009; Zimmerman, 1986, 1998, 2002) as well.

Elite youth sports is an ideal context to study the use of reflection as athletes are constantly pushing their boundaries to improve in an effort to attain senior elite status. Toering and colleagues (2009) showed that 12-to 16-year-old elite youth soccer players outscored their sub-elite peers on reflection. Similarly, Jonker and colleagues (2010) reported that the junior internationals discriminated themselves from their peers competing nationally on the basis of their reported use of reflection, in addition to other self-regulatory skills (e.g., planning, self-efficacy and effort). The authors suggested that the best athletes may have benefitted more from the time spent on training by means of reflection.

Although the trajectory towards the top may differ between sports, most athletes are faced with a relatively small window of opportunity to improve. Moreover, the number of athletes qualified to compete at a given level of competition decreases as competitive level increases (Elferink-Gemser, 2004; Ericsson, 1996) and as a result most athletes are deselected from their talent development programs before they reach senior international status (Côté, Baker, & Abernethy, 2003; Elferink-Gemser, Visscher, Lemmink, & Mulder, 2007). Optimal usage of reflection during the talent years seems beneficial in realizing one's full potential as an athlete (Jonker et al., 2010; Toering et al., 2009).

In the developmental literature, the possibility to use reflection in order to optimize the learning process seems to run parallel with the years of talent development in most sports (i.e., 12-18 years). From a metacognitive perspective, children start to develop skills such as reflection from an early age (4 to 6 years; Alexander et al., 1995; Veenman & Spaans, 2005). At this young age, metacognitive skills are domain-specific in nature and are thought to increase with age. From approximately 12 years of age, children are expected to be able to use their metacognitive skills with their repertoire developing into a set of domain general skills that can be applied within and between several learning domains (Alexander et al., 1995; Van der Stel & Veenman, 2008; Veenman & Spaans, 2005). Similarly, neurodevelopmental psychology proposes that executive functions, generally defined as psychological processes such as reflection that are involved in the conscious control of thought and action, develop from an early age. Again, children reach adult-level performance on standardized tests of executive functioning at approximately 12 years of age and these capabilities are thought to be domain-general in nature (Zelazo & Müller, 2002).

In sum, although the relation between hours spent on training and ultimate attainment has been shown in prior research (e.g., Ford et al., 2009; Helsen et al., 1998; Hodges & Starkes, 1996; Starkes et al., 1996), more insight is needed regarding what athletes actually derive from their training sessions (e.g., Ericsson, 2003; Jonker et al., 2010; Peltier, Hay, & Drago, 2005). The purpose of the present study was to assess the use of reflection of elite youth athletes 2.5 years before their age-related transition to senior competitions (i.e., from junior to senior age) and to relate their levels of reflection to their attained competitive level at senior age (i.e., international or national). To accomplish the purpose of unraveling the specific role of reflection in expertise, and in line with prior research showing relationships between reflective capacity, age, sport-related data and attained senior competitive status, elite youth athletes who made a successful transition to senior international level were matched (by age and training variables) to their counterparts in national competitions when they were junior athletes. We expected that elite youth athletes with the highest levels of reflection were more likely to compete at the international level when they are seniors, thereby emphasizing the value of reflection in reaching expertise.

Method

Participants

In the 2006-2007 and 2007-2008 competitive seasons a representative sample of approximately 1000 elite youth athletes were measured from across The Netherlands. As we wanted to predict attained senior competitive level as early as possible, only elite youth

Table 1. Age, training related data (Mean and *SD*), gender and academic level (*n* and %) of the senior internationals (*n* = 26) and senior nationals (*n* = 26) when they were juniors.

	Senior internationals		Senior nationals	
	Mean	*SD*	Mean	*SD*
Age (yrs)	16.03	1.37	15.77	1.48
Age of entry in their sport (yrs)	6.69	1.93	6.54	1.88
Sport experience (yrs)	9.35	2.43	9.23	2.32
Training (hrs/wk)	13.56	8.72	12.99	8.70
	n	%	*n*	%
Gender				
Male	7	26.9	11	42.3
Female	19	73.1	15	57.7
Academic level				
Pre-university	25	96.2	24	92.3
Pre-vocational	1	3.8	2	7.7

Note. baseball (*n* = 2), handball (*n* = 2), field-hockey (*n* = 2), gymnastics (*n* = 6), judo (*n* = 6), soccer (*n* = 16), speed-skating (*n* = 10), tennis (*n* = 6), volleyball (*n* = 2). * $p < .05$.

athletes 3 or 2 years before their moment of transition were included. One-hundred and sixty-three athletes (66 male and 97 female) remained who were approximately 2.5 years before their age-related transition to senior competitions in their sport. At that time, all athletes were considered as 'youth elites' on the basis of their participation in a talent development program in either baseball, field hockey, gymnastics, handball, judo, speed-skating, soccer, tennis, or volleyball. More specifically, all competed at the highest competitive levels (i.e., national or international) in their respective age group and belonged to the best 2.5% of athletes (Netherlands Olympic Committee*Netherlands Sports Federation [NOC*NSF]). Of these 163 elite youth athletes, 38 athletes (23.31%) reached senior

Table 2. Age, training related data (Mean and *SD*), sport competing in, gender and academic level (*n* and %) of the four combined competitive level subgroups when they were juniors.

	Junior international/ Senior international (*n* = 14)		Junior international/ Senior national (*n* = 5)		Junior national/ Senior international (*n* = 12)		Junior national/ Senior national (*n* =21)	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Age (yrs)	15.79	1.48	16.80	1.64	16.33	1.23	15.52	1.36
Age of entry in their sport (yrs)	6.57	2.21	7.00	3.16	6.83	1.64	6.43	1.54
Sport experience (yrs)	9.21	2.55	9.80	3.90	9.50	2.39	9.10	1.89
Training (hrs/wk)	16.60*	10.78	10.40	4.63	10.01*	3.19	13.61	9.40
	n	%	*n*	%	*n*	%	*n*	%
Sport competing in								
Baseball	1	7.1	1	20.0	0	0.0	0	0.0
Handball	0	0.0	0	0.0	1	8.3	1	4.8
Field-hockey	1	7.1	0	0.0	0	0.0	1	4.8
Gymnastics	3	21.4	0	0.0	0	0.0	3	14.3
Judo	3	21.4	1	20.0	0	0.0	2	9.4
Soccer	3	21.4	3	60.0	5	41.7	5	23.8
Speed-skating	1	7.1	0	0.0	4	33.4	5	23.8
Tennis	2	14.5	0	0.0	1	8.3	3	14.3
Volleyball	0	0.0	0	0.0	1	8.3	1	4.8
Gender								
Male	4	28.6	2	40.0	3	25.0	9	42.9
Female	10	71.4	3	60.0	9	75.0	12	57.1
Academic level								
Pre-university	13	92.9	5	100.0	12	100.0	19	90.5
Pre-vocational	1	7.1	0	0.0	0	0.0	2	9.5

Note. * $p < .05$

international status in the competitive season 2010-2011 and remained in this study. Athletes are classified as being of international status if they are active in competitions such as World Championships, European Championships, Grand slams, Champions League football or Europe League football, and the Olympics and belong to the best 0.5% of athletes (NOC*NSF).

As previous research showed a relationship between reflective thinking and age, and training variables and attained senior competitive status, the 38 eventual senior internationals were matched with same-age counterparts who did not reach senior international status for the first part of our study. In order to be included in the matched analyses, athletes from both groups had to have competed in the same sports, be of similar age when reflection was assessed, were similar in age of entry in their sports, years of sport experience and number of training hours per week as their later senior nationals during their junior years. Eventually, 7 male and 19 female later senior internationals were matched with 26 counterparts (11 male and 15 female) who did not reach senior international status. Twelve senior internationals were dropped from our analyses as we were not able to match them with a later senior nationally competing counterpart. Their reflective data was similar to that of the 26 senior internationals who remained in the study; $U = 137.500$; $z = -.587$; $df = 37$; $p = .557$. The mean of the internationals who were dropped from the analyses was 4.23 ($SD = .36$) and mean of the internationals that remained was 4.32 ($SD = .45$). Table 1 shows the general characteristics of the elite youth athletes when they entered the study (i.e., in the 2006-2007 or 2007-2008 seasons) categorized by the attained senior competitive level (i.e., international or national) in 2010-2011.

For the second part of the study, senior internationals and senior nationals were further classified into four competitive level subgroups based on their combined junior competitive level (junior international or junior national) and senior competitive level (senior international or senior national) to control for possible differences in junior competitive level. The first group included athletes who were internationals as junior and retained this status in their senior years (i.e., junior internationals/senior internationals;

n = 14). The second group was made up of junior internationals that decreased in their competitive level between their junior and senior years (i.e., junior internationals/senior nationals, n = 5). The third group included junior nationals that increased in competitive level between junior and senior age (i.e., junior national/senior internationals; n = 12) while the final group reflected athletes who were nationals during their junior years and remained at this level as seniors (i.e., junior nationals/senior nationals; n = 21). Table 2 shows the general characteristics of the four subgroups.

Procedure

The procedures were in accordance with the standards of the local medical ethics committee of the leading institute. Athletes, the athletes' parents and the schools were informed and gave their verbal consent to participate. In the presence of test leaders, participants completed the reflection subscale of the Self-Regulated Learning – Self-Report Scale (SRL–SRS; Toering, Elferink-Gemser, Jonker, van Heuvelen, & Visscher, in press) in a classroom setting during their regular school activities in either 2006-2007 or 2007-2008.

The 2010-2011 competitive levels of the athletes (i.e., competing internationally or nationally) were extracted from the NOC*NSF database, from the databases of the sports federations (i.e., Royal Dutch Baseball and Softball Association, Royal Dutch Handball Association; Royal Dutch Hockey Federation, Royal Dutch Gymnastics Federation, Dutch Judo Association, Royal Dutch Skating Federation, Dutch Volleyball Federation; Royal Dutch Tennis Federation; Royal Dutch Football Association) or from the Association of Tennis Professionals (ATP) and Women's Tennis Association (WTA) tennis rankings. On the basis of their competitive level in the season 2010-2011, all internationals were matched with athletes competing nationally on the following variables: age, age of entry in their sports, years of sport experience, and number of training hours per week. This means that the senior internationals competed in the same sports as the senior nationals, were of approximately the same age (i.e., they differed maximally 1 year in age which is consistent with the Dutch competition structure), were about the same age when they entered their sport (i.e., they differed maximally 3 years), had similar years of experience in their sports (i.e., they differed maximally 3 years), and had similar training hours per week (i.e., they differed maximally 3 hours per week) when the athletes filled out the questionnaire as juniors in the 2006-2007 or 2007-2008 seasons.

Although all athletes were part of a talent development program as juniors, and were matched on training related characteristics, it may still be the case that the athletes already differed in their competitive level (i.e., junior international or junior national level). To control for this phenomenon we also extracted the competitive level of the athletes in the seasons 2006-2007 and 2007-2008 from the NOC*NSF and Sports Federations' databases. This information was used for the second part of our study.

Instrument

As noted above, the SRL–SRS was used (Toering et al., in press), which measures participants' personal details (e.g., date of birth) and their sport-related data (e.g., sport(s) involved, age of entry, number of years of experience in their sport, and number of training hours per week) as well as their self-reported use of self-regulatory skills. The SRL–SRS has found to be a reliable and valid (content and construct) instrument measuring self-regulation in general learning contexts and was based on Zimmerman's (1986) work (i.e., content validity; Toering et al., in press). For the purpose of the present study the reflection subscale of the SRL–SRS was used. This is a 5-item Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) measuring the extent to which respondents are able to appraise what they have learned and to adapt their past knowledge and experiences to improve themselves. Table 3 shows the items of the questionnaire as well as the considered observed correspondence in content with Zimmerman's sub processes of self-reflection.

Toering and colleagues (in press) assessed the reliability and construct validity by two confirmatory factor analyses (CFA) with different samples between 12 and 17 years

Table 3. The reflection subscale of the SRL-SRS (Toering et al., in press).

Item		Zimmerman's sub process of	Mean scores of the subgroups per item				
			Senior internationals	Senior nationals	Difference in mean	*p*	*d*
1	I reappraise my experiences so I can learn from them.	Self-evaluation and adaptive inferences	4.15 (.54)	3.85 (.37)	.30	.063	.65
2	I try to think about my strengths and weaknesses.	Causal attributions	4.31 (.74)	4.19 (.49)	.12	.537	.19
3	I think about my actions to see whether I can improve them.	Self-evaluation and adaptive inferences	4.54 (.51)	4.15 (.46)	.39	.033	.80
4	To understand new ideas, I think about my past experiences.	Self-evaluation and adaptive inferences	4.27 (.67)	3.92 (.69)	.35	.134	.51
5	I try to think about how I can do things better next time.	Causal attributions and adaptive inferences	4.35 (.56)	4.12 (.33)	.23	.115	.50

Note. Subscale was originally based on the *Reflection* subscale of the *Reflective Learning Continuum* by Peltier and colleagues (2006). Questions were scored on a 5-point Likert-type scale ranging from strongly disagree to strongly agree.

of age. The first CFA showed that an adjusted six-factor model was an acceptable fit to the data with factor loadings for the 5 reflection items ranging from .62 to .72. The CFA of the second sample reproduced these results and supported the validity of the SRL–SRS. The temporal and absolute test-retest reliability was examined using a subpopulation of the first sample (n = 290) that filled out the questionnaire twice with a four-to-six week time interval. The ICC for reflection was .84 which supports the relative temporal stability of this scale. In addition, the mean difference between both measurements was not significant, meaning that the absolute temporal stability was sufficient as well. Furthermore, the Cronbach's alpha was α = .78 (Toering et al., in press) which determined a sufficient internal consistency. Similarly, the Cronbach's alpha in the present study was α = .86.

Analyses

Data were analyzed using SPSS 17.0. Mean scores and standard deviations on reflection for the senior internationals and the senior nationals were calculated. A Mann-Whitney U test was performed to examine whether the scores for reflection differed between the senior internationals and the senior nationals as measured when they were all junior athletes. According to Mann and Whitney (1947) a non-parametric test is better to use with unequal or small sample sizes. Reflection served as the dependent variable with senior international or senior national level as between subjects factor. Using a Mann-Whitney U test enabled us to match the senior internationals with their nationally competing counterparts on important influential factors (i.e., the matching variables noted earlier) with sufficient power (i.e., power = .80). This would not have been possible using logistic regression.

To determine whether senior athletes already differed in their competitive level (international or national) as juniors, which may also relate to their levels of reflection (Jonker et al., 2010), we examined the four groups (i.e., group 1: junior international/senior international, group 2: junior international/senior national, group 3: junior national/senior international, group 4: junior national/senior national; see Figure 1 for a summary of groups and overview of analyses) using six Mann-Whitney U tests to assess possible differences on reflection between the four subgroups. In these analyses, reflection served as the dependent variable with the four subgroups as independent variables.

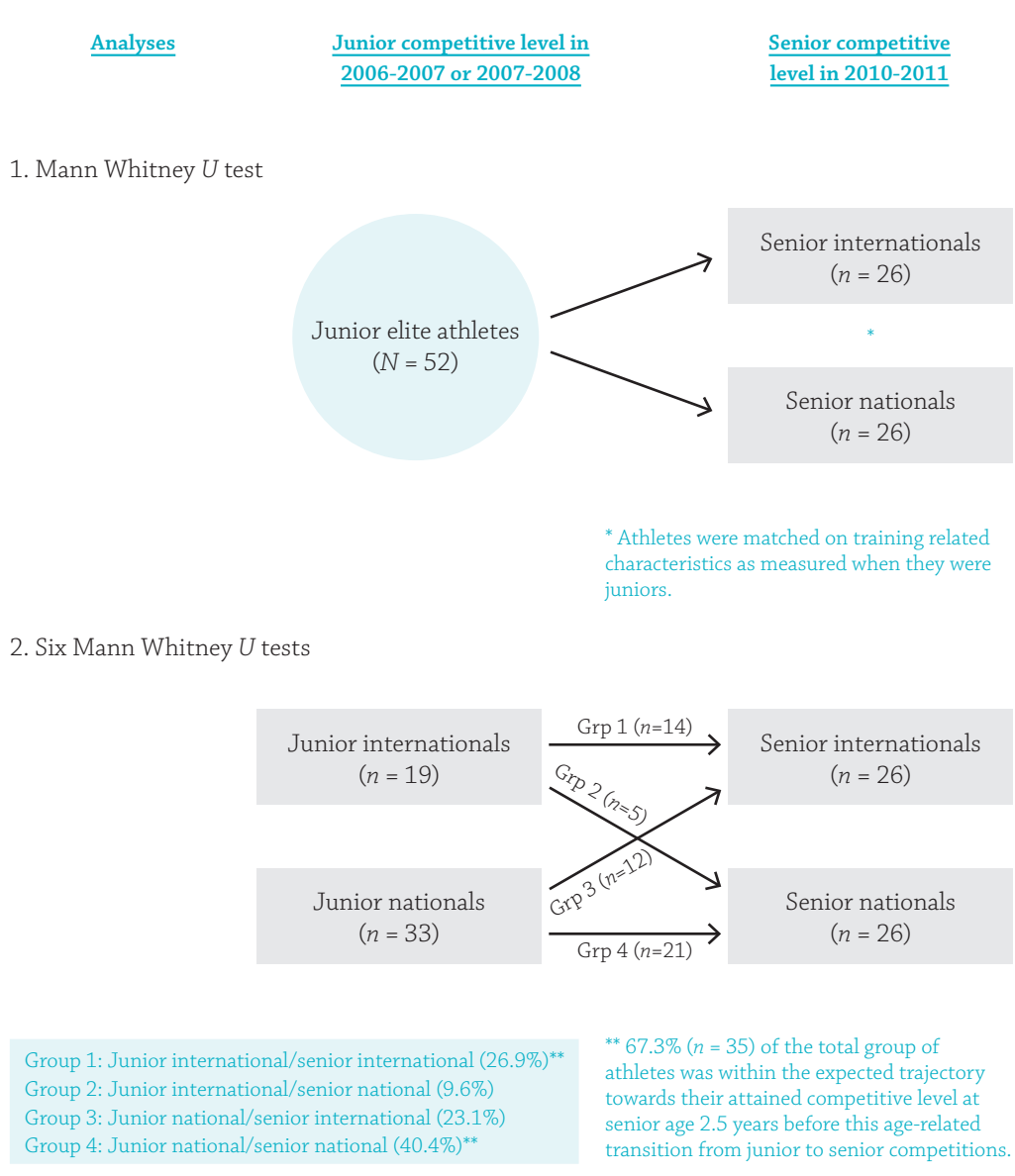
Mann Whitney U tests were executed as follow-up analysis to assess possible differences between subgroups on specific items of the reflection scale. An alpha level of .05 was adopted for all tests and the Bonferroni correction was applied. Effect sizes (d) were calculated to interpret the scores. Effect sizes around 0.20 are considered small, around 0.50 moderate and around 0.80 large (Cohen, 1988).

Results

First part: difference between senior internationals and senior nationals

The results of the Mann-Whitney U test showed that when measured as juniors, the senior internationals (mean = 4.32, SD = .45) had significantly higher scores on reflection than their senior nationally competing peers (mean = 4.05, SD = .28), U = 220.000; z = -2.189; df = 51; p = .029; the senior interna-

Figure 1. Overview of analyses for the first and second part of the study and summary of groups according to combined junior and senior international or national competitive levels.



tionals had an average rank of 31.04, while the senior nationals had an average rank of 21.96. This effect was accompanied by a fairly large effect size, d = .72. Table 3 revealed that the later senior internationals outscored their later nationally competing peers particularly on 'thinking about actions to improve' (item 3); U = 238.500; z = -2.138; df = 51 ; p = .033; d = .80. No significant results were found on the other items, but a moderate-to-large effect size was observed for 'reappraising experiences to learn' (item 1), and moderate effect sizes for 'to understand new ideas, I think about experiences' (item 4) and 'thinking about how I can do things better next time' (item 5). A small effect sizes was found for 'thinking about strengths and weaknesses' (item 2; Table 3).

Second part: Differences between the four competitive level subgroups

Table 4 shows the mean scores (and standard deviations) on reflection and the item scores for the four combined junior and senior international and national subgroups. The Mann-Whitney U tests showed that the junior national/senior international subgroup (group 3) differed significantly from the junior national/senior national subgroup (group 4) on reflection, U = 57.500; z = -2.615; df = 32; p = .009 with the junior national/senior internationals reporting higher reflection than their junior national/senior national counterparts (average ranks of 22.71 and 13.74 respectively). The corresponding effect size was large, d = 1.01. No significant differences were found between the other subgroups (p > .05) and the effect sizes ranged from small between groups with similarity in the attained senior competitive levels (i.e., group 1 vs. group 3; d = -.31, and group 2 vs. group 4; d = .12) to moderate and large when comparing between the other subgroups (see Table 4).

Mann-Whitney U tests on the specific items showed no significant effects between the four subgroups (p > .05). Corresponding effect sizes are displayed in Table 4 and ranged from small to large. The athletes who increased or decreased between their junior and senior competitive level were randomly distributed over the sports included in the present study.

Table 4. Means and standard deviations on the total scale of reflection (Mean and *SD*) and per item (Mean and *SD* for the four subgroups based on the combined junior and senior competitive levels of the athletes.

	Combined junior and senior competitive level subgroup							
	Junior international/ senior international (JISI; n = 14)		Junior international/ senior national (JISN; n = 5)		Junior national/ senior international (JNSI; n = 12)		Junior national/ senior national (JNSN; n = 21)	
Item	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
1	4.14[a]	0.36	3.80[a]	0.44	4.17[a]	0.72	3.86[b]	0.36
2	4.14[a]	0.86	4.20[a]	0.45	4.50[a]	0.52	4.19[a]	0.51
3	4.50[a]	0.52	4.20[a]	0.45	4.58[a]	0.52	4.14[b]	0.48
4	4.14[a]	0.66	3.80[a]	0.84	4.42[a]	0.67	3.95[b]	0.67
5	4.36[a]	0.50	4.40[a]	0.55	4.33[a]	0.65	4.05[b]	0.22
Total	4.26[a]	0.47	4.08[a]	0.39	4.40[a]	0.43	4.04[b]	0.26
Range (min – max)	3.60	5.00	3.60	4.60	3.60	5.00	3.40	4.40

Note. Corresponding effect sizes between:

- JISI and JISN were small for items 2 and 5 (d = -.09 and d = -.08), moderate for items 3 and 4 (d = .62 and d = .45), large for item 1 (d = .85), and moderate (d = .42) for the total score on reflection.
- JISI and JNSI were small for items 1, 3 and 5 (d = -.05, d = -.15, and d = .05), moderate for items 2 and 4 (d = .51 and d = .42), and small (d = -.31) for the total score on reflection.
- JISI and JNSN were small for items 2 and 4 (d = -.07 and d = .29), large for items 1, 3 and 5 (d = .78, d = .72, and d = .80), and moderate (d = .56) for the total score on reflection.
- JNSI and JISN were small for item 5 (d = -.12), moderate for items 1 and 2 (d = .62 and d = .62), large for items 3 and 4 (d = .78 and d =.82), and large (d = .78) for the total score on reflection.
- JNSI and JNSN were moderate for items 1, 2, and 5 (d = .54, d = .60 and d = 58), large for item 3 and 4 (d = .88 and d = .70), and large (d = 1.01) for the total score on reflection.
- JISN and JNSN were small for item 1, 2, 3, and 4 (d = -.15, d = .02, d = .13, and d = -.20), large for item 5 (d = .84), and small (d = .12) for the total score on reflection.

[ab] Within each row, means having the same letter in their superscripts are not significantly different from each other at the .05 level.

Discussion

Our analyses used data with a future time component to assess whether elite youth athletes with the highest self-reported levels of reflection were more likely to attain senior international status. Knowledge about the role of reflection in sport expertise can give coaches and athletes increased understanding about how elite youth athletes learn and how their learning process can be optimized during talent development, ultimately leading to superior performance. Results of the first part of our study, where junior internationals and junior nationals were matched on a range of critical variables, supported our hypothesis that junior athletes who attained senior international status displayed more frequent use of reflection during their years as juniors. This suggests that the senior internationals

may have derived more from their practice sessions even though both groups had similar hours spent on practice (Cleary & Zimmerman, 2001; Ericsson, 1998; Ertmer & Newby, 1996; Jonker et al, 2010; Peltier et al., 2006; Toering et al., 2009) and as a consequence were better able to improve in the restricted time period towards the transition to senior competitions.

When we relate the content of the items on which the later senior internationals differed most from their later nationally competing peers (i.e., 'thinking about actions to improve' and 'reappraising experiences to learn'; items 1 and 3 as shown by the effect sizes in Table 3) to Zimmerman's sub processes of reflection, it seems that the later senior internationals use more information from past experiences (Zimmerman's sub process of self-evaluation), but also seem willing to adjust their past strategies to improve next time (Zimmerman's sub process of adaptive inferences). As these items possess a kind of openness to new ideas and willingness to modify, we consider those aspects in line with Mezirow's (1991) point of view as well.

In the second part of our study, we attempted to gain more knowledge about the relationship between reflection and attainment of senior status by subdividing the athletes into four combined junior and senior competitive levels. In this new analysis, junior competitive level was taken into account, as athletes may have differed in junior competitive level, but moreover this analysis may reveal possible changes in junior and senior competitive levels related to athletes' use of reflection. This analysis displayed that the twelve (23.1%) junior nationals/senior internationals (i.e., those who increased in competitive level from junior to senior age) had similar or even slightly higher scores on reflection than their peers who were already junior internationals and remained internationals at the senior level (i.e., 4.40 vs. 4.26 respectively; Table 4). In addition, their mean scores were significantly higher than their junior national peers who did not make it to senior international level. The mean scores on reflection of the five (9.6%) junior internationals/senior nationals (i.e., those athletes who decreased in competitive level from junior to senior age) was similar to the scores of the athletes who were nationals during their junior years and remained nationals at senior age (i.e., 4.08 vs. 4.04 respectively, Table 4).

Above mentioned findings are interesting as they show that almost 35% of the junior athletes were not in the athletic track leading to their attained senior competitive level (Figure 1) and relations with their use of reflection were found. Namely that most of the athletes who scored high on reflection were still able to increase in their competitive level between their junior and senior years, while those who were junior nationals and stayed nationals at senior age had significantly lower reflective mean scores (Table 4). Furthermore, the lowest score of the latter group (Table 4) refers to *neutral* which means that athletes do not always agree to reflect or do not know whether they reflect, while the lowest score of the junior nationals/senior internationals refers to *agree*. The highest score of the junior nationals/senior nationals refers to *agree,* while the highest score of the junior nationals/senior internationals refers to *strongly agree*. This indicates that those junior nationals who became senior internationals at least always agree to use reflection. We suggest that coaches and youth scouts should be aware of this phenomenon. They need to facilitate their athletes who are allowed to compete in international competitions at junior age with the best opportunities to make progression (Elferink-Gemser et al., 2011), but also their nationally competing peers should have access to the best opportunities to improve and must receive high-quality attention from coaches. Since, this study points out that 23.1% of the later senior internationals are still competing nationally 2.5 years before the transition to senior competitions (Figure 1). Based on the results of the current study, we recommend trainers and coaches to monitor their athletes' levels of reflection as making use of these skills towards the moment of transition may be related to making a successful transition from junior to senior age.

More practically these differences in reflective scores showed that the junior nationals/senior internationals improved their competitive level enough to be able to compete at senior international levels of competition and reported the frequent use of reflective skills suggesting that the senior internationals may have improved their sport specific skills as a consequence of their optimal usage of reflection. Although no significant effects were observed, closer examination of the differences in their item scores (Table 4), indicates they may have benefited most from their increased use of 'thinking about actions to improve' and 'to understand new ideas, I think about experiences' (items 3 and 4) as is shown by large and moderate-to-large effect sizes. These aspects are in line with Zimmerman's sub processes of self-evaluation and adaptive inferences. For the junior internationals/senior nationals the opposite may be true since they had lower scores on reflection than their international junior peers who made it to the senior international level. When looking to differences in item scores, the junior internationals/senior nationals scored relatively low on 'thinking about actions to improve' and 'to understand new ideas, I think about experiences' (items 3 and 4) compared to the athletes who attained senior international status (Table 4). It should, however, be acknowledged that this last group consisted of five athletes only.

When relating items of our questionnaire to Zimmerman's (2000) sub processes of reflection, we have to acknowledge that our instrument does not include the sub process of self-satisfaction. To recapitulate, self-satisfaction refers to learners' feelings of satisfaction or dissatisfaction against one's performance (Zimmerman, 2000) and has, thereby an influence on learners' subsequent effort and approach to learning. It may therefore, well be the case that the senior internationals differ from the senior nationals on self-evaluation and adaptive inferences due to an increased satisfaction and confidence of the senior internationals in their own capabilities. Bandura (1991) showed that learners with increased feelings of self-satisfaction are more likely to adapt their behavior to improve in future tasks. Furthermore, he emphasized that the more task-specific character of self-satisfaction as people are generally more familiar with making judgments on task-specific forms of performance. Although our results are still considered valuable as they shed light on the predictive value of reflection for those who are going to make it to the top, we recommend for future studies to use more qualitative measurements including Zimmerman's sub process of self-satisfaction.

An other weak point is related to the use of a general self-report questionnaire. Using self-report is not without discussion. There is, for example, ongoing debate regarding whether people are able to report

their thoughts and cognitions appropriately (Eccles, in press; Nisbett & Wilson, 1977). Besides that, we have to acknowledge that what we know from our results is that the later senior internationals say to reflect more frequently, but what remains unclear is where the senior internationals have exactly reflected on and why they chose for that subsequent action or strategy to improve in a range of different possibilities. How and if this was reflected in behavior remains unknown as well. Nevertheless, a recent study of Toering and colleagues (2011) showed positive and significant correlations between the self-report instrument used in the present study and behavioral observations for reflection as part of self-regulation as reported by expert coaches in elite youth soccer (Toering, Elferink-Gemser, Jordet, Jorna, Pepping, & Visscher, 2011). Still, it would be valuable for future research to develop instruments that can assess athletes' use of reflection more qualitatively.

In addition, our results were based on elite youth athletes' scores on reflection at solely one moment during development (i.e., 2.5 years before transition). For future studies, we recommend to use longitudinal data as this may reveal the value of reflection during several phases of development of expertise. Furthermore, analyses were performed with relatively small sample sizes. Although, the power of our main analyses are considered sufficient (see above), and which is underlined by the moderate-to-large and large effect sizes, some other analyses may lack power. A high power avoids making a type 1 error which in this case would mean that we assume that senior internationals outscore their senior national peers on reflection while in fact they do not. This should be acknowledged when interpreting our results. Furthermore, one might argue that the two sets of analyses in the present study are somewhat redundant as the athletes could have been matched on junior competitive level within the first analysis as well. Besides, the fact that this would leave us with even smaller sample sizes, the results of the second analysis further contributes to the value of reflection during development of expertise as it reveals not only numbers of athletes that still changed in competitive levels between junior and senior years, but it also emphasizes its relation with their self-reported use of reflection. We therefore consider the execution of both analyses as a strength of our study.

Other strengths of our study relate to the future time component of our research design since most research with young athletes has been conducted retrospectively (e.g., Helsen et al., 1998; Hodge & Starkes, 1996; Starkes et al., 1996). In our study, we were able to track athletes of the highest competitive levels in their sports across their stages of development. This reveals better information about this critical period than examining the recalled perspectives of athletes who have reached elite status (Côté, 1999; Holt & Dunn, 2004), which may be subject to a range of recall biases. In addition, even though discussion exists regarding whether reflection should be measured as domain-specific or domain-general, we think that in this age category measurement of domain-general reflection is a strength. Not only can the results of the present study be compared with those of experts in other domains, Wylleman and colleagues (2004) noted that athletes aged 10-to-22 years are faced with important transitions on athletic, psychological, academic, and/or individual levels (Wylleman, Alfermann, & Lavallee, 2004). In line with Mezirow's (1991) point of view on reflection, we assume that in order for athletes to improve they need to balance these shifts and use all relevant information in their lives to understand themselves and their learning process.

An additional strength of the current analysis is that it assessed the levels of reflection of younger athletes who are still in high school, an age group rarely considered in skill acquisition and talent development research. Thus, results of the present study contribute to existing literature in that specifically reflection as aspect of self-regulation has predictive value for those who attained the highest competitive status in sport. Research with athletes at these extremely high levels of competition is valuable in itself, but we were also able to track them during development. We did not know during research who was going to make it and who was not. To our knowledge, most research has emphasized the value of reflection solely during development without relating it to the attainment of success at senior age, or assessed it retrospectively which is more susceptible to recall biases (Côté, 1999; Holt & Dunn, 2004). Though measured with a self-report questionnaire, which has its limitations as well (see above), this study was one of the first able to access athletes during development, namely 2.5 years before transition. Although, the relationships between Zimmerman's (2000) subprocesses of reflection should be further assessed in future research, the present study sheds light on the importance of specific sub processes of reflection in the attainment of senior internationals status.

Although this study emphasizes to value of reflection, it is also in line with the main idea of the deliberate practice theory (i.e., that expert performance is closely related to the accumulated numbers of hours of training; Côté et al., 2007; Ericsson et al., 1993). All senior internationals competed in their sport of expertise for more than 10 years before their transition to senior competitions, started at an early age and spent large numbers of hours of training in their sport per week (Table 1 and Table 2). In addition to Ericsson's (2003) proposition that cognitive involvement is necessary in order to attain higher levels of performance, the present study shows the value of reflection in reaching senior international level. In addition to research showing the value of the accumulated numbers of training hours of athletes (e.g., Falk et al., 2004; Ford et al., 2009; Helsen et al., 1998), our results emphasize that reaching senior international status is more multifaceted than merely accumulating hours of deliberate training (Baker, Côté, & Abernethy, 2003; Ericsson, 1998). Athletes who reached senior international status displayed higher scores on reflection as juniors and, perhaps more interestingly, athletes who increased in competitive level from junior national to senior international reported using reflection even more frequently. It seems that maximizing one's potential by means of reflection may ultimately determine attainment at the senior level (i.e., international vs. national level).

In conclusion

Our results have several implications for athletes, trainers and coaches. In general, identifying athletes with high and low levels of reflection as juniors may be informative since these levels of reflection seem to predict attainments as seniors. More importantly,

coaches and trainers should be aware that athletes at lower levels of junior competition are still able to make the transition to higher levels as seniors. Athletes competing nationally as juniors who displayed high levels of reflection were still able to reach senior international status. Furthermore, when working with athletes who are physically 'gifted' but with low levels of reflection, coaches and trainers should be conscious of the role of reflection in the attainment of senior international level. Furthermore, and as mentioned in the introduction, most elite youth athletes are deselected from their talent development programs in their journey to the top. Our results suggest that some of these athletes fail to reach senior international status due to an insufficient use of their reflective skills.

More practically, in case of soccer player X and speed-skater Y, we assume that they would never have obtained success when they kept on training simply like they did, or when they were not aware of their own abilities and disabilities on which they based their strategies to improve. Previous research in educational settings has suggested that the development and use of reflection can be taught (Cleary, Platten, & Nelson, 2008; Masui & De Corte, 2005) and coaches and trainers may wish to put this into practice. This means that trainers and coaches should approach their athletes individually to set personal goals of attainment based on athletes' willingness to invest, personal strengths and weaknesses, the competitive level of competitors, and assess different possibilities to improve as an outcome of shared reflective thinking. Furthermore, trainers and coaches should be aware of their own capabilities related to their athletes' goals and should be willing to ask advise from other specialists to improve their athletes' performance. This means that training methods must become more personally and athlete-centered, in which the athlete takes control over learning and is involved processes of goal-setting and planning. Further research is needed to develop a reflective intervention from a talent developmental perspective in youth sports. From this point of view, helping athletes to develop their reflective skills may help them exert more control over their learning process and benefit more from their training sessions.

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Chapter 9

The development of reflection and attainment of senior international status in elite sports

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Abstract

Elite youth athletes commit to extensive numbers of training hours. Nevertheless, what they derive from this training may be very important in making a successful transition to senior elite level. The best athletes learn more efficiently and differentiate themselves on reflection – the capacity to use past knowledge to improve in the future. This study assessed reflection among 54 elite youth athletes 4 years before their transition up to the moment of transition using multilevel modeling of longitudinal data. A randomly assigned control group (n=28) was used to verify model fit. Results showed that in the 4-year period before transition, senior internationals had higher scores on reflection than nationals, but the development was stable for both groups over time. No significant results were found for other factors such as sport training, sport experience, type of sport and gender. These results suggest that what elite youth athletes derive from training is related to the senior competitive level they attain. Elite youth athletes' reflection scores can assist in predicting which athletes have the best chance of reaching the top. Coaches and researchers are challenged to develop ways to support athletes to use reflective thinking in order make a successful transition to senior level.

Keywords: *Reflective skills, expert performance, longitudinal study, talent development*

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Introduction

In recent decades, a lot of research has attempted to assess why some elite youth athletes reach the top while others fail. Several sport-specific components, including psychological, technical, and tactical skills, have been related to attainment of senior elite status in sport (Kannekens, Elferink-Gemser, & Visscher, Epub ahead of print; Huijgen, Elferink-Gemser, Post, & Visscher, 2009; Roescher, Elferink-Gemser, Huijgen, & Visscher, 2010), but aspects such as the accumulated number of training hours and an athlete's use of cognitive skills have been found to be important as well (Ericsson, Krampe, & Tesch-Römer, 1993; Ericsson, 2003). In The Netherlands, youth athletes can take part in competitive sports at different levels of performance classified by chronological age.

Athletes who have been identified as most athletically gifted and with the potential to reach senior elite status (i.e., elite youth athletes) frequently compete at the highest competitive level in their age category and are selected to be part of a talent development program as well. This means that they are often provided with extra training facilities supervised by highly certified trainers to give them the best opportunities to improve towards senior level (Baker, Horton, Robertson-Wilson, & Wall, 2003). Nevertheless, the time to improve for athletes towards the moment of transition to senior level is limited and the age at which athletes have to make this transition differs between sports (Table 3).

After transition, most athletes struggle with the increased level of competition and greater number of competitors as chronological age is no longer taken into account (MacNamara & Collins, 2010). From a talent development perspective, the use of reflective skills seem crucial for youth athletes striving to attain senior elite status, since these skills are considered to increase a person's learning efficiency (Jonker, Elferink-Gemser, & Visscher, 2010; Jonker, Elferink-Gemser, de Roos, & Visscher, in press). Furthermore, some studies have assessed the development of reflection as part of metacognition or executive functioning (Van der Stel & Veenman, 2008; Zelazo & Müller, 2002) related to chronological age; however, less is known about the development of reflection related to the different ages at which elite youth athletes have to make the transition to senior competition. Therefore, the purpose of the present study is to assess the development of reflection in elite youth athletes four years before transition up to the moment of transition, taking age, gender, junior or senior competitive level, training hours, sport experience and type of sport into account.

Dewey (1933) was one of the first to suggest that the use of reflective skills can help people to improve their problem-solving skills and increase learning efficiency. Several decades later Zimmerman (1986, 2000) and Mezirow (1991) reasoned that by the frequent use of reflection, people are generally better able to understand themselves and what it takes to improve future performance based on previous knowledge and experience. More specifically, Zimmerman (2000) considered reflection as the last phase in his self-regulated learning theory. According to this theory, self-regulated learners are those who are metacognitvely, motivationally and behaviorally proactive participants in their learning process (Zimmerman, 1986, 2006). Self-reflection is involved in this cyclical process of self-regulation, including forethought (i.e., before learning efforts), performance (i.e., during learning) and self-reflection phases (i.e., after learning). During the self-reflection phase people use knowledge obtained during the forethought and performance phases to engage in subprocesses such as self-evaluation of goal progress (i.e., comparisons of self-observed performance against some standard), causal attributions (i.e., classifying causes of success and failure), feelings of self-satisfaction, and adaptive inferences (i.e., adapting one's behavior and decisions to use previous performances to improve next time; Zimmerman, 2000). According to Mezirow (1991), critical reflection is not only helpful in using previous knowledge and experience, highly reflective learners are generally better able to look for new ways to reorient their problem-solving behavior in a more effective way.

In elite sports, the value of the use of reflective skills has been established already

(Jonker et al., 2010; Kitsantas & Zimmerman, 2002). Kitsantas and Zimmerman (2002), for example, showed that when compared to non-experts and novices, expert volleyball players tend to evaluate more often and attributed their failures to technique-oriented deficiencies more frequently, from which they were able to self-correct their next actions and were more often willing to adapt their behavior to change things in future actions to improve. In the context of talent development, Jonker and colleagues (2010) reported that among six self-regulatory skills, reflection discriminated best among 12- to 16-year-old youth athletes classified as internationals (i.e., the best 1% in their age category) and nationals (i.e., the best 2.5% in their age category). The authors showed that the junior internationals, irrespective of the sport they participated in, had higher scores on reflection (Jonker et al., 2010).

In a follow-up study, Jonker and colleagues (in press) related the use of reflection among 26 junior internationals and 26 junior nationals to their attained senior competitive level 2.5 years later when they had to make the age-related transition to senior competition. Their results showed that, regardless of junior competitive level, number of training hours, and years of sport experience, the later senior internationals reported using reflection more frequently 2.5 years before the transition than their later senior nationally competing peers. Furthermore, the athletes who increased in competitive level from junior national to senior international level had similar scores as their junior international peers who made a successful transition to senior international level. The junior internationals who decreased in competitive level towards senior national level had similar scores as their peers who were nationals as juniors and remained nationals as seniors. It seems, therefore, that the use of reflection may have a predictive value for becoming a senior international athlete (Jonker et al., in press). Nevertheless, the development of reflective thinking in the period before transition is still unknown.

Developmental studies have shown that people in general are considered to develop skills such as reflection from the early age of 2 to 6 years and that these skills increase with age (see Alexander, Carr, & Schwanenflugel, 1995 for a review; Zelazo & Müller, 2002). When children are approximately 12 years of age, they are expected to be able to use their reflective skills and their repertoire is thought to develop from a more domain-specific set of skills to a general set that can be applied within and between several learning domains (Van der Stel & Veenman, 2008). Also, from a neurodevelopmental perspective, a child's brain is supposed to have matured enough to be able to use skills such as reflection (i.e., as part of executive functions) when children are approximately 12 years of age and this capacity increases during adolescence (Sebastian, Burnett, & Blakemore, 2008; Zelazo & Müller, 2002). These research findings are interesting in this study's perspective as, for example, elite youth female gymnasts and swimmers are 12 years of age when they have four years to go before the transition to senior level (Table 3).

In addition, it has been reported that people can develop reflective thinking as part of self-regulation in a goal-directed environment in which they are provided with feedback (Boekaerts & Corno, 2005). Research on how to give corrective feedback showed that if autonomy-supportive feedback that takes athletes' perspectives into account and fosters their understanding of why feedback was

given as corrective information was provided with a meaningful and specific rationale, this was most advantageous for athletes to stay motivated and thereby promote performance improvement (Mouratidis, Lens, & Vansteenkiste, 2010; Van Ark, Elferink-Gemser, Roskam, & Visscher, 2010). In this perspective, it is suggested that elite youth athletes are familiar with the possibility of thinking reflectively through their commitment to deliberate practice. This means that they have to spend approximately 10,000 hours in their sport over a prolonged period of 10 years (Ericsson et al., 1993). As a consequence, they commit to a context that is highly goal-oriented and in which they are continuously provided with feedback by their trainers, coaches, peers and by their performance outcomes. Even though several researchers have established a relationship between the accumulated number of training hours and attained senior status (e.g., Ford, Ward, Hodges, & Williams, 2009; Helsen, Starkes, & Hodges, 1998), more recent studies have emphasized the ability to derive more from similar large numbers of training hours, for example by means of reflection (Jonker et al., in press). This is consistent with the initial ideas of the deliberate practice theory as athletes need to stay focused and reinvent themselves constantly to counteract automaticity (Ericsson, 2003).

As has been described earlier, most elite youth athletes are part of a talent development program (i.e., best 2.5% of athletes in their age category in The Netherlands). Their competitive level may, however, still differ. Following Jonker and colleagues (2010, in press), elite youth athletes can be subdivided into junior internationals and junior nationals. The junior internationals compete among the best 1% of athletes in their age category while the junior nationals compete among the best 2.5%. On the one hand, Jonker and colleagues (2010) showed that 12 to 16-year-old junior internationals outscored their same-age nationally competing peers on their use of reflection. On the other hand, Jonker and colleagues (in press) reported that 35% of the athletes were not in the athletic track leading to their attained senior competitive level. Athletes who scored high on reflection were still able to increase their competitive level between junior and senior levels. This in contrast to athletes who scored relatively low on reflection and more frequently decreased in their competitive level (Jonker et al., in press).

Even though, to the authors' knowledge, no differences have been reported in prior research between athletes playing team sports and those taking part in individual sports in their use of reflection (Jonker et al., 2010), it is possible to argue that differences exist in the type and frequency of use of reflection between athletes in different types of sport. To elaborate, athletes playing team sports perform in a constantly changing environment, whereas the surroundings in individual sports remain relatively stable during performance (Elferink-Gemser, Visscher, & Lemmink, 2008). Furthermore, the performance outcome of athletes playing team sports is valued by trainers and coaches and depends on a combination of various mini performances that contribute to the overall team performance (Elferink-Gemser et al., 2008; Régnier, Salmela, & Russell, 1993), whereas athletes taking part in individual sports are more affected by their own performance and less dependent on others during practice and for their performance outcomes (Elferink-Gemser et al., 2008; Régnier et al., 1993). This may have an influence on an athlete's use of reflection. Prior research reported minimal gender differences in self-regulation in a population of elite athletes (Anshel & Porter, 1996).

In sum, reflection has been reported as of importance for talent development and in the attainment of senior international status as measured 2.5 years before transition. Knowledge about the development in elite youth athletes striving for the top in the four-year period before transition and whether these junior levels of reflection are related to senior attained status is still limited. Therefore, this study sought to assess the development of reflection in elite youth athletes four years before transition up to the moment of transition using longitudinal data. The possible effects of number of training hours per week, years of sport experience, junior competitive level, type of sport, age and gender were evaluated.

Methods

Participants

During 2007-2010, 82 elite youth athletes (aged 12-17 years) took part in a longitudinal study assessing their self-reported use of reflection. All athletes were considered as junior elites in field hockey, gymnastics, handball, judo, soccer, speed-skating, swimming, tennis or volleyball on the basis of their participation in a talent development program in The Netherlands. Membership of such programs means they are considered to be among the best 2.5% of athletes in their age category.

The 82 athletes were then subdivided into a research population and a control population based on the number of measurements taken. Measurements were taken on a yearly basis over a four-year period. Thus, athletes were measured every year in the period March-May between 2007 and 2010. Fifty-four participants were measured twice or more and were therefore selected to belong to the research population. Of them, 26 elite youth athletes were tested on two occasions (52 measurements), 23 on three occasions (69 measurements), and 5 on all four occasions (20 measurements), which resulted in 141 measurements relatively equally distributed over the sports involved. Twenty-eight athletes were measured once and were therefore included to serve as the control population to verify the model fit.

Research population

Of the 54 elite youth athletes, 19 attained senior international status after their age-related transition (5 male; 14 female). Being designated as internationals means that these athletes are active in competitions such as World Championships, European Championships, Grand Slams, Champions League football or Europe League football, and the Olympics. They belong to the best 0.5% of athletes in the Netherlands (NOC*NSF).

The other 35 athletes (16 male; 19 female) became nationals after their transition. These athletes compete in national competitions and in national championships, but they are not selected to represent the Netherlands in international tournaments and competitions. Table 1 shows the general characteristics of the participants.

Control population

The above-mentioned 54 athletes were included in a multilevel model assessing the use of reflection four years before the age-

Table 1. Means (and standard deviations) on junior age, senior age, sport training (hours per week), and sport experience (years), number and percentage of athletes related to type of sport, and gender for the senior internationals and the senior nationals designated as the research population four years before transition up to the moment of transition.

	Senior internationals[a]										Senior nationals[b]													
	Years before transition to senior level										Years before transition to senior level													
	-4 years (*n*=3)		-3 years (*n*=13)		-2 years (*n*=15)		-1 year (*n*=12)		1st year senior (*n*=5)		Total (*n*=48)		-4 years (*n*=6)		-3 years (*n*=20)		-2 years (*n*=28)		-1 year (*n*=23)		1st year senior (*n*=16)		Total (*n*=93)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Junior age (yrs)	14.8	0.7	15.3	1.4	16.4	1.4	17.3	1.3	17.2	1.1	16.3	1.5	15.1	1.3	16.0	1.1	16.6	1.2	17.0	0.8	17.8	0.7	16.7	1.2
Senior age (yrs)	18.5	0.7	18.7	1.4	18.9	1.5	19.3	1.3	19.5	1.7	19.0	1.3	19.1	0.7	19.3	1.1	19.2	1.1	19.0	1.2	19.3	1.1	19.2	1.1
Sport training (hrs/wk)	8.0	3.1	15.4	13.5	16.1	12.1	17.7	10.5	21.5	11.6	16.4*	11.6	6.5	3.2	10.1	7.7	11.5	8.7	11.3	7.9	13.4	9.8	11.2*	8.3
Sport experience (yrs)	8.0	0.0	9.1	1.9	10.1	2.2	10.3	2.7	9.0	2.6	9.6	2.2	6.5	3.6	8.4	2.8	8.8	3.1	8.7	2.8	10.4	2.3	8.8	3.0
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Type of sport																								
Team	2	66.7	5	38.5	6	40.0	5	41.7	1	20.0	19	39.6	4	66.7	11	55.0	15	53.6	13	56.5	8	50.0	51	54.8
Individual	1	33.3	8	61.5	9	60.0	7	58.3	4	80.0	29	60.4	2	33.3	9	45.0	13	46.4	10	43.5	8	50.0	42	45.2
Gender																								
Male	0	0.0	4	30.8	5	33.3	4	33.3	0	0.0	13	27.1	2	33.3	10	50.0	14	50.0	9	39.1	5	31.3	40	43.0
Female	2	100	9	69.2	10	66.7	8	66.7	5	100	35	72.9	4	66.7	10	50.0	14	50.0	14	60.9	11	68.8	53	57.0

Note. [a] 13 measurements were obtained for junior nationals who increased in attained competitive level and became senior internationals. These 13 measurements refer to 8 junior nationals/senior internationals, which is equal to 14.8% of the total group of elite youth athletes (n = 54). Of the 14.8% of athletes who increased in competitive level, 28% increased at the moment of transition. [b] 13 measurements were obtained for junior internationals who decreased in attained competitive level and became senior nationals. These 13 measurements refer to 7 junior internationals/senior nationals, which is equal to 13.0% of the total group of elite youth athletes (n =54). Of the 13.0 % of athletes who decreased in competitive level, 75% decreased 1 year before transition (25%) or at the moment of transition (50%). Some of these athletes switched between competitive level more than once. 72.2% of the athletes were in the athletic track leading to their attained senior competitive status. * $p < .05$.

related transition to senior levels of competition up to the moment of transition. The remaining 28 athletes from the initial 82 athletes, were used to verify the appropriateness of the model. This group consisted of 14 athletes who attained senior international status (4 male; 14 female) and 14 athletes who attained senior national status (4 male; 14 female). The general characteristics of the control population are shown in Table 2.

Instrument

The Self-Regulation of Learning Self-Report Scale (SRL–SRS; Toering, Elferink-Gemser, Jonker, van Heuvelen, & Visscher, in press) was used to measure the athletes' personal details (i.e., date of birth and gender), their sport-related data (i.e., the number of training hours per week, their years of sport experience, the sport they participated in) and their self-reported use of reflection. The reflection subscale consists of five items measuring reflection on a Likert-type scale (Table 4) that ranged from 1 (*strongly agree*) to 5 (*strongly disagree*). High scores on this subscale indicate a low level of reflection and reversed scores were used in our analyses.

The SRL–SRS was reported to be re-

Table 2. Means (and standard deviations) on junior age, senior age, sport training (hours per week), and sport experience (years), number and percentage of athletes related to type of sport, junior competitive level, and gender for the senior internationals and the senior nationals designated as the control population four years before transition up to the moment of transition.

	Senior internationals [a]										Senior nationals [b]									
	Years before transition to senior level										Years before transition to senior level									
	-4 years (*n*=0)		-3 years (*n*=7)		-2 years (*n*=5)		-1 years (*n*=2)		Total (*n*=14)		-4 years (*n*=1)		-3 years (*n*=4)		-2 years (*n*=8)		-1 years (*n*=1)		Total (*n*=14)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Junior age (yrs)	-	-	15.3	0.5	16.0	1.4	18.0	1.4	15.9	1.3	15.0	0.0	15.3	0.5	16.5	0.9	17.0	-	16.1	1.0
Senior age (yrs)	-	-	17.7	0.8	19.4	1.5	21.0	1.4	19.3	1.3	17.0	0.0	18.0	0.8	19.9	1.3	20.0	-	19.5	1.1
Sport training (hrs/wk)	-	-	10.2	3.8	17.0	10.5	11.0	1.4	12.7	7.2	10.5	0.0	8.4	2.4	8.8	3.9	4.5	-	8.5	3.3
Sport experience (yrs)	-	-	7.9	1.8	9.6	2.4	10.0	5.7	8.8	2.6	11.0	0.0	8.8	1.0	9.4	2.8	12.0	-	9.5	2.3
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Junior comp. level																				
International	-		4	57.1	4	80.0	2	100	10	71.4	1	100	0	0.0	2	25.0	0	0.0	3	21.4
National	-	-	3	42.9	1	20.0	0	0.0	4	28.6	0	0.0	4	100	6	75.0	1	100	11	78.6
Type of sport																				
Team	-	-	3	42.9	3	60.0	2	100	8	57.1	0	0.0	0	0	8	100	1	100	9	64.3
Individual	-	-	4	57.1	2	40.0	0	0.0	6	42.9	1	100	4	100	0	0.0	0	0.0	5	35.7
Gender																				
Male	-	-	3	42.9	0	0.0	1	50.0	4	28.6	1	100	2	50.0	1	12.5	0	0.0	4	28.6
Female	-	-	4	57.1	5	100	1	50.0	10	71.4	0	0.0	2	50.0	7	87.5	1	100	10	71.4

Note. [a] of the 14 athletes who became senior internationals, 4 athletes increased and were nationals at junior level (i.e., 14.3%). [b] Of the 14 athletes who became senior nationals, 3 athletes decreased and were internationals at junior level (i.e., 10.7%). This means that 25.0% of the elite youth athletes were not in the athletic track leading to their attained senior competitive status.

liable for adolescents between 11 and 17 years of age and its content and construct validity was supported as well (Toering et al., in press). The Cronbach's alphas for the reflection subscale for the research (α = .76) and the control population (α = .70) in the present study were considered sufficient.

Procedure

All participants were informed about the study's procedures and provided verbal consent. Informed consent was also obtained from their parents and schools. The procedures were in accordance with the standards of the local medical ethics committee of the leading institution, which conform to the World Medical Association declaration of Helsinki. Measurement took place in a group setting in the presence of test leaders. Athletes were informed that the results would be used anonymously. After completion of the questionnaire, training hours per week were evenly divided into four categories (category 0: ≤ 6 hours per week, category 1: > 6 hours per week, category 2: > 9 hours per week, category 4: > 13 hours per week). The database of the Netherlands Olympic Committee and Netherlands Sports Federation (NOC*NSF) was used to determine the junior and senior competitive levels of the athletes. As elite youth athletes in dissimilar types of sport differ in age when they have to make

Table 3. Age of transition to senior competition for male and female elite youth athletes per sport.

Sport	Age of transition		Number of athletes per sport (*n* [%])			
	Male	Female	Research population		Control population	
			n	%	*n*	%
Field hockey	18+	18+	6	11.1	2	7.1
Gymnastics	18+	16+	7	13.0	1	3.6
Handball	21+	20+	4	7.4	1	7.1
Judo	18+	18+	2	3.7	4	14.3
Soccer	18+	18+	11	20.3	11	39.3
Speed-skating	18+	18+	7	13.0	4	14.3
Swimming	18+	16+	3	5.6	0	0.0
Tennis	18+	18+	9	16.6	2	7.1
Volleyball	18+	18+	5	9.3	2	7.1

Table 4. Reflection items (related to Zimmerman's subprocesses of self-reflection), item mean scores (and standard deviations), and ranges (minimum; maximum), and effect sizes for the later senior internationals (n = 19; 48 measurements) and senior nationals (n =35; 93 measurements).

	Reflection items	Item mean scores						Zimmerman's subprocess of self-reflection
		Senior internationals			Senior nationals			
		Mean Min.	*SD* Max.	dif	Mean Min.	*SD* Max.	*d*	
1	I reappraise my experiences so I can learn from them.	4.21 3.00	0.50 5.00	0.39	3.82 2.00	0.69 5.00	0.65	Self-evaluation and adaptive inferences
2	I try to think about my strengths and weaknesses.	4.46 2.00	0.65 5.00	0.24	4.22 2.00	0.64 5.00	0.37	Causal attributions
3	I think about my actions to see whether I can improve them.	4.54 4.00	0.50 5.00	0.29	4.26 2.00	0.66 5.00	0.48	Self-evaluation and adaptive inferences
4	To understand new ideas, I think about my past experiences.	4.08 2.00	0.68 5.00	0.25	3.83 2.00	0.70 5.00	0.36	Self-evaluation and adaptive inferences
5	I try to think about how I can do things better next time.	4.44 3.00	0.62 5.00	0.21	4.23 3.00	0.55 5.00	0.36	Causal attributions and adaptive inferences
	Total construct of reflection	4.35 3.60	0.39 5.00	0.29	4.06 2.80	0.48 5.00	0.66	The ability to apply prior experiences to improve subsequent performances in a goal-directed and effective way

the transition, Table 3 shows the transition age, and the number of athletes per sport for the research and the control population.

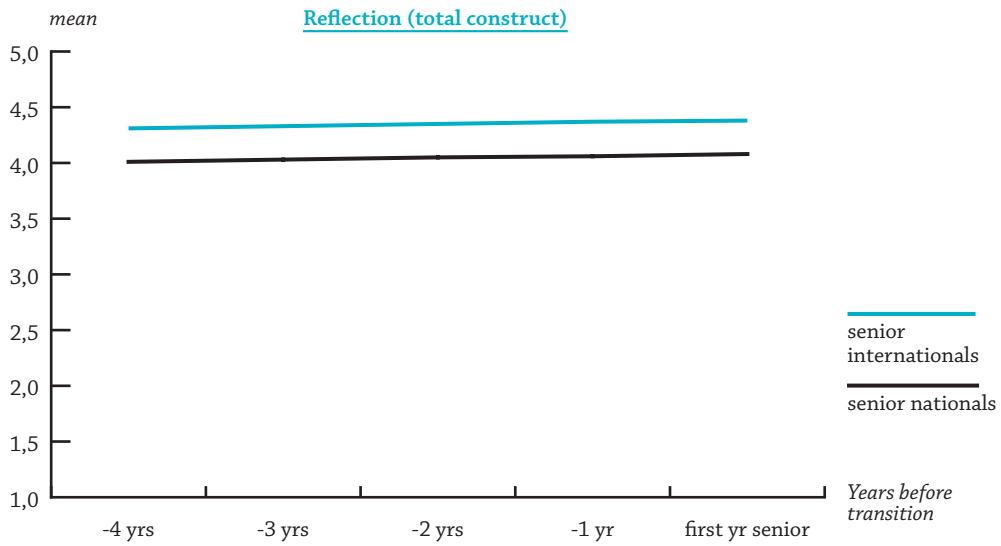
Data analysis

The longitudinal development of the use of reflection was examined using the multilevel modeling program MlwiN 2.02 (Rasbash, Browne, Goldstein, Yang, Plewis, Draper et al., 1999). Multilevel modeling is a regression analysis that is appropriate for hierarchically structured data. In our longitudinal data set, a two-level hierarchy was defined with the repeated measurements (level 1 units) grouped within the participants (level 2 units). In the multilevel model we chose to account for levels 1 and 2 variance. As such, the model describes not only underlying population trends in reflection (the fixed part of the model), but also models the variation around this mean response due to the time of measurement and individual differences (the random part of the model; Snijders & Bosker, 2000). The model properly accounts for correlations amongst repeated measurements within individuals (Peugh & Enders, 2005), and the advantage of using multilevel modeling is that it controls for differences in the number of measurements and the temporal spacing of the measurements between individuals (Landau & Everitt, 2004; Maas & Snijders, 2003; Peugh & Enders, 2005). The obtained results are valid as long as the missing data are random, which is the case in our study, since the missing observations did not relate to reflection.

The procedure described in Snijders and Bosker (2000) was followed to determine the consecutive steps in our model. First, a satisfactory variance structure for reflection in our dataset was established using the number of years to transition. Based on previous theory, we first modeled the difference between the senior competitive level subgroups (i.e., senior internationals or senior nationals) and the difference between junior competitive levels, taking the interaction with age (measured in months and divided by 12) into account. Subsequently, differences in the number of training hours x age and years of sport experience x age were modeled. Then, the type of sport the athletes competed in (i.e., team or individual) was modeled. In the last step, the effect of gender was examined.

Note. Effect sizes of approximately d = .20 are considered small, d = .50 moderate, and d = .80 large (Cohen, 1988). Subscale was originally based on the *Reflection* subscale of the *Reflective Learning Continuum* by Peltier and colleagues (2006). Questions were scored on a 5-point Likert-type scale ranging from *strongly agree* to *strongly disagree*. Items were reversed scored in our analyses.

Figure 1a. Multilevel model for reflection for the senior internationals and senior nationals 4 years before transition up to the moment of transition.

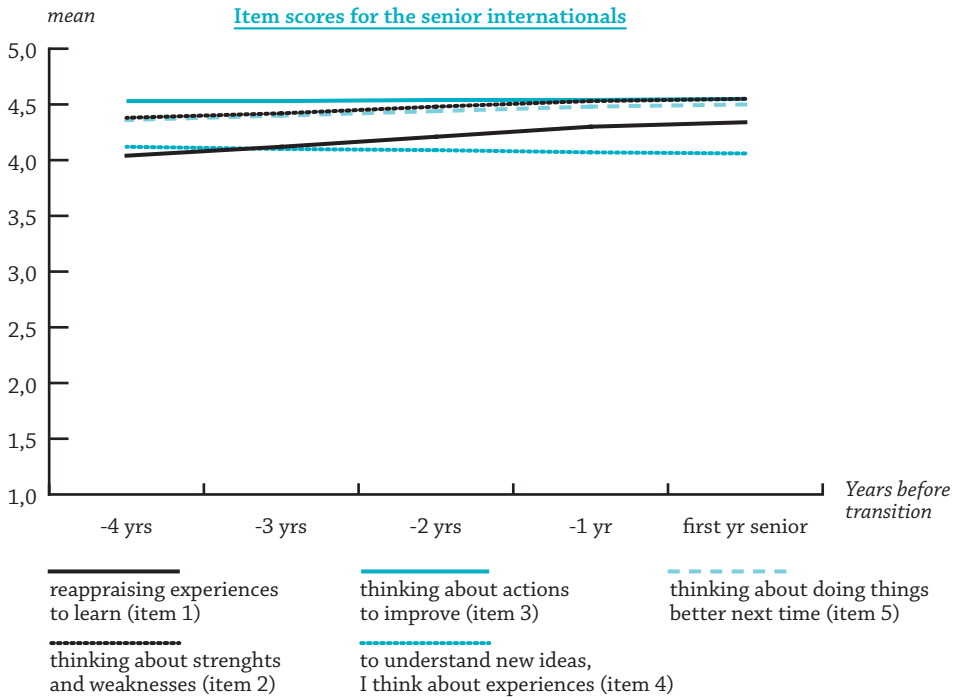


	Years before transition					*Standaard deviations*				
	-4 yrs	-3 yrs	-2 yrs	-1 yr	first yr senior					
senior internationals	4.31	4.33	4.35	4.37	4.38	0.0	0.0	0.0	0.0	0.01
senior nationals	4.01	4.03	4.05	4.06	4.08	0.01	0.0	0.01	0.01	0.0

During this step-forward method, the significance of previous variables was constantly checked. Variables that were not significant were excluded from the model with the exception of our first step in the model, the number of years before transition to senior competition. By comparing the deviance of the empty model (i.e., model without predicting variables) and the subsequent models, the model fit was evaluated.

To test the appropriateness of our model, scores obtained from the model were compared with the actual scores of the control group using a Wilcoxon signed rank test and by using Bland-Altman analysis (1986). The Bland-Altman technique calculates the bias between two methods of measurement by comparing the mean differences. In this case, the actual mean scores of the athletes are compared to the mean score acquired by the model. In this technique, a 95% confidence interval was used and is considered to include 95% of differences between the two measurement methods. The smaller the range between these two measurements, the better the agreement, and it was therefore tested

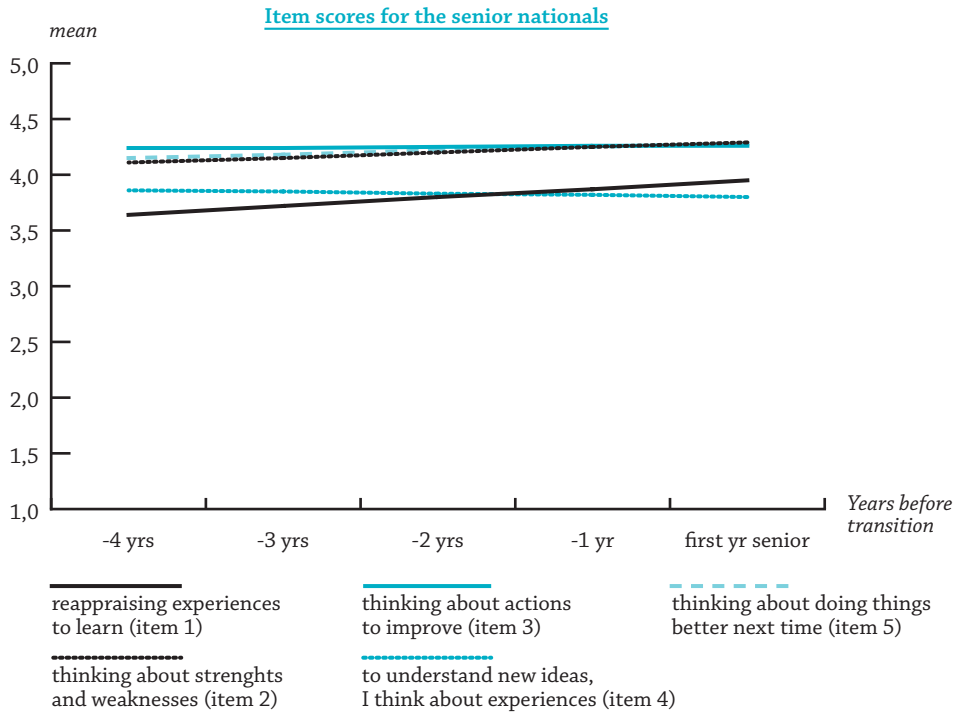
Figure 1b. Multilevel model for the seperate item scores on reflection for the senior internationals and senior nationals 4 years before transition up to the moment of transition.



	Years before transition				
	-4 yrs	-3 yrs	-2 yrs	-1 yr	first yr senior
reappraising experiences to learn (item 1)	4.04	4.12	4.21	4.3	4.34
thinking about strenghts and weaknesses (item 2)	4.38	4.42	4.48	4.53	4.55
thinking about actions to improve (item 3)	4.53	4.53	4.54	4.54	4.55
to understand new ideas, I think about experiences (item 4)	4.12	4.1	4.09	4.07	4.06
thinking about doing things better next time (item 5)	4.36	4.4	4.44	4.48	4.5

Standaard deviations				
0.01	0.02	0.02	0.02	0.07
0.01	0.01	0.01	0.01	0.04
0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.01
0.01	0.01	0.01	0.01	0.03

Figure 1b. continuation.



whether zero lay within the 95% confidence interval of the mean difference. An alpha of 0.05 was adopted for all tests of significance.

Results

Research population

Table 4 shows the mean scores and standard deviations for the senior internationals and senior nationals on the total construct of reflection and for the separate items. In the development of reflection, a significant difference was observed for senior competitive level (i.e., senior international or senior national; $p < .05$; Figure 1a). Even though the use of reflection for the senior internationals and the senior nationals was stable in the period four years before the transition up to the moment of transition ($p > .05$), the senior internationals had higher scores on reflection than the nationals at all moments of measurement ($p < .05$). Figure 1a shows the development of reflection for the senior internationals and the senior nationals. In Figure 1b the development ($p > .05$) and contribution of each item to the total construct of reflection is displayed.

No significant results were found in the relationship between reflection and junior competitive level, number of training hours per week, years of sport experience, type of sport (team or individual) and gender ($p > .05$) and these variables were removed from the model. Table 5 presents the final model parameters.

Control population

To verify the appropriateness of the model, the actual mean scores and standard deviations on reflection for the control population were compared to the mean scores and standard deviations on reflection obtained by using the model (Table 5). Table 6 shows the results of the Wilcoxon signed rank test and the Bland-Altman technique. The results of the Wilcoxon signed rank test revealed that the actual reflective scores of the athletes were not significantly different from the mean score acquired by the model ($p > .05$). The results of the Bland-Altman technique showed that zero lay within the 95% confidence interval of the mean difference.

Table belongs to Figure 1b *Item scores for the senior nationals.*

	Years before transition				
	-4 yrs	-3 yrs	-2 yrs	-1 yr	first yr senior
reappraising experiences to learn (item 1)	3.64	3.72	3.8	3.87	3.95
thinking about strenghts and weaknesses (item 2)	4.11	4.15	4.2	4.25	4.29
thinking about actions to improve (item 3)	4.24	4.24	4.25	4.26	4.26
to understand new ideas, I think about experiences (item 4)	3.86	3.85	3.83	3.82	3.8
thinking about doing things better next time (item 5)	4.15	4.18	4.22	4.25	4.28
	Standaard deviations				
	0.03	0.02	0.01	0.02	0.02
	0.02	0.01	0.01	0.01	0.01
	0.0	0.0	0.0	0.0	0.0
	0.01	0.0	0.0	0.0	0.0
	0.01	0.01	0.01	0.01	0.01

Discussion

The present study sought to assess the development of reflection in elite youth athletes four years before transition up to the moment of transition taking general and sport-related characteristics into account using longitudinal data. Our results showed that the development of reflection is stable in this four-year period for athletes who attained senior international status and for those who became nationals. However, the scores of the senior internationals were already significantly higher four years before transition and remained significantly higher, regardless of

Table 5. Multilevel model and parameters for reflection four years before transition and senior attained level (141 measurements).

Fixed effects	Coefficients	S.E.	t-value	p-value
Constant	4.08	0.077		
Years before transition	0.018	0.033	0.545	> .050
Senior competitive level	0.304	0.094	3.234	.002
Random effects				
Intercept	0.046	0.022		
Residual variance	0.153	0.023		
Deviance	166.507			
Deviance empty model	185.414			

Table 6. Actual mean score (and standard deviation) and mean score (and standard deviation) obtained from the model on reflection for the control population of later senior internationals and later senior nationals, results from the Bland-Altman method and Wilcoxon signed rank test.

	Reflection scores						Bland-Altman		Wilcoxon signed rank		
	Actual score (AS)		Score from the model (SM)		AS-SM		SE for AS-SM	*95% CI for AS-SM*	*Z*	*df*	*p*-value
	M	*SD*	*M*	*SD*	*M*	*SD*					
Senior internationals (*n*=14)	4.20	.46	4.34	.01	-.14	.46	.12	-.40 – .12	-.22	13	.83
Senior nationals (*n*=14)	4.04	.25	4.04	.01	.01	.25	.07	-.14 – .15	-1.2	13	.24
Total population (*n*=28)	4.12	.37	4.19	.16	-.07	.37	.07	-.21 – .75	-.89	27	.37

the age at which athletes have to make the transition. This suggests that reflection is an important characteristic for elite youth athletes on their road to the top. The control group confirmed model fit as the actual mean scores on reflection did not differ significantly from the acquired mean score. In addition, as zero lay within the 95% confidence interval the absolute reliability was supported as well. This indicates that based on the athletes' reflective scores obtained with our instrument, the attained senior competitive level can be predicted by comparing the scores from the instrument with the figure presented in this study (Figure 1a).

Even though it is not yet clear whether the senior internationals in the present study have an innate ability to reflect more on practice and performance or whether they have developed their reflective skills during their lives probably in the period before our measurements, prior research on the educational setting showed that reflection can be stimulated when youth is prompted to use reflective thinking (e.g., Peters & Kitsantas, 2010). Furthermore, MacNamara and Collins (2010) showed that preparing elite youth athletes purposefully for transitions in their athletic careers helped them to develop the requisite psychological characteristics for developing excellence (i.e., goal-setting, planning, motivation). We therefore suggest that intervention studies and guidelines on how to prompt elite youth athletes to use reflective thinking on their road to the top be developed, thus increasing their chances of making a successful transition to senior competition.

In the present study, no significant results were found on sport-related variables such as junior competitive level, number of training hours per week, sport experience and type of sport in relation to reflection. With respect to junior competitive level, approximately 28% of the elite youth athletes were not in the athletic track (i.e., junior international or national) leading to their attained senior competitive status four years before transition (Table 1). Of the athletes who decreased in competitive level from junior international to senior national level, 75% decreased relatively late in their talent years. More specifically, 25% of them decreased in the year before transition and 50% at the moment of transition, while our measurements were equally distributed over the three-year period before transition. This suggests that reflection becomes increasingly important as the moment of transition draws closer. It is interesting to notice that the mean score on reflection of the junior internationals/senior nationals was relatively low (M = 3.83; SD = .47, range 2.80 – 4.40), and significantly lower than the mean score of the athletes who increased in competitive level from junior national to senior international level (M = 4.31; SD = .47; range 3.80 – 5.00). In this perspective, the mean score of the latter group of athletes is in line with the junior internationals who became senior internationals as well (see Table 4). Interestingly, 30% of the junior nationals/senior internationals were identified as nationals during their talent years but

attained international status at the moment of transition. It can be shown that those elite youth athletes who were initially identified as physically less gifted as expressed by being junior nationals, and were able to improve enough during the talent years and consequently become senior internationals, reported using reflection comparatively often. This is emphasized by a lowest mean score of 3.80, which refers to *agree* and therefore indicates that athletes at least always agree to use reflection. Athletes initially identified as being more athletically gifted as expressed by being junior internationals, but who were not able to attain senior international status, reported using reflection 'now and then', as the lowest mean score of this group refers to *neutral* while the highest mean score refers to *agree*. This means that athletes do not always agree to use reflection or do not know whether reflection has been used. These results underpin the value of reflection in attaining senior international status and is consistent with prior research showing that 35% of elite youth athletes still change in competitive level 2.5 years before transition and that these changes are related to elite youth athletes' scores on reflection (Jonker et al., in press).

Following on from this, the use of reflection seems specifically important at the moment of transition as most junior internationals decrease in competitive level in the year before or at the moment of transition. Therefore, in line with MacNamara and Collins (2010), we suggest that athletes who do not make use of the psychological characteristics of developing excellence during training in order to progress, and who do not take responsibility for their own development, both considered to be related to reflection, will have difficulty with the transition to a higher competitive standard. Although our results stress the value of reflection in this respect, it would be interesting to assess athletes' use of reflection in the period shortly after and a few years after transition as well. To elaborate, the oldest athletes in the present study competed at senior level for 3 years (n = 2) and it may therefore well be the case that some nationals still become selected to compete internationally while some senior internationals will lose their status over the years. Unfortunately, we did not measure the levels of reflection of the athletes in the present study after their first year as a senior; however, changes in competitive level later in their careers may be related to their use of reflection as seniors.

With respect to the absence of significance in training-related data (i.e., training hours and sport experience), we assume that our findings are nonetheless consistent with the deliberate practice theory. Athletes in the present study reported spending numbers of hours on training per year in line with those reported by Côté and colleagues (2003); these numbers increased towards senior level, and athletes had approximately 10 years of experience in their sport at the moment of transition (Table 1; Côté, Baker, & Abernethy, 2003). In this perspective, our results confirm that spending extensive numbers of hours in practice is a necessity for all athletes in order to reach the top. It should, however, be acknowledged that the later senior internationals have spent more time on training (Table 1), and were also found to reflect more frequently, but that their increased levels of reflection are not related to the numbers of hours spent on training, as was shown by the model. This may suggest that the later senior internationals not only spend more time on training on their road to the top, but also derive more from their training sessions.

The senior internationals discriminate themselves from the nationals on the basis of a difference in reflection score of approximately 0.30 on a 5-point Likert scale (Table 4), which is equal to 7.75%. This apparently small difference is considered relevant due to its content and because of the knowledge that winning or losing at these high levels of competition is determined by very small differences between athletes, and is emphasized by the moderate-to-large effect size in Table 4 as well. Similar to the variations in mean score reported above, the elite youth athletes who attained senior international status, irrespective of junior competitive level, reported lowest scores on reflection referring to *agree* (i.e., 3.60; Table 4) indicating that they at least always agree to use reflection, whereas the lowest reflective scores of the senior nationals refer to *neutral* (i.e., 2.80; Table 3), meaning that they do not always agree or do not consciously know whether they reflect. Based on these results, we suggest that the later senior internationals may have benefitted more from training and practice as they are better able to set realistic improvement goals based on prior experience and their own strengths and weaknesses.

Although our results showed stability in the total construct of reflection four years before transition up the to the moment of transition, the contribution of each item to the total construct of reflection appears to differ and the later senior internationals appear to discriminate themselves most on Zimmerman's (2000) subprocesses of self-evaluation and adaptive inferences (see effect sizes on items 1, 3 and 4 in Table 4). Strictly speaking, the development of the separate items should be considered stable as well, though the developmental trends of 'reappraising experiences to learn' (item 1) and 'to understand new ideas, I think about experiences' (item 4) seem to deviate from the total construct of reflection (Figure 1b). The mean scores of these two items seem to be relatively low four years before transition and the slope of 'reappraising experiences to learn' seems more steep, whereas the trend line of 'to understand new ideas, I think about experiences' shows a slight decrease. These results may be explained on the one hand by an increased ability of youth in later adolescence to use self-knowledge and past experiences for reflective objectives than youth earlier in adolescence due to the relatively late development of the medial prefrontal cortex in adolescence (Sebastian et al., 2008). On the other hand, there seems to be a changing role of the coach from more controlling to a more reciprocal coach-athlete relationship (Côté et al., 2003; Trudel, 2006). Thus, good coaches are assumed to adapt their way of coaching to the developmental phases of the individual athlete (Van Ark et al., 2010), and acknowledge the increased ability to set goals of improvement based on reflection on prior experiences closer to the moment of transition.

In theorizing this, we would have expected both 'reappraising experiences to learn' and 'to understand new ideas, I think about experiences' to increase towards the moment of transition, but this is only the case for 'reappraising experience to learn'. By carefully re-examining the content of both items, we noticed that 'to understand new ideas, I think about experiences' seems to have a different content *before* the process of goal-setting takes place. More specifically, the content of 'to understand new ideas, I think about experiences' appears to refer to an athlete's action to appraise what is already known or experienced after he or she is confronted by a new idea, for example

guided by the trainer, which is suggested to be more commonly done during earlier developmental phases. 'Reappraising experiences to learn', on the other hand, appears to refer to an athlete's action to reappraise what has already been experienced to set goals of improvement accordingly. As suggested above, the autonomy of athletes to set goals and take responsibility for their own development becomes more important closer to transition. Furthermore, we propose that the very best athletes do not stop at meeting the demands of the commonly established competitive level or rely on the structure of coaches, but look continuously for new ways to reinvent themselves to improve.

This is in line with Mezirow's (1991) and Zimmerman's (1986, 2006) points of view on self-regulative learners (i.e., those who are metacognitively, motivationally and behaviorally proactive participants in their own learning process). It is too early to draw conclusions based on these two items, and though a lot of research has already been conducted on successful coaching behavior (e.g., MacNamara & Collins, 2010; Mouratidis et al., 2010; Van Ark et al., 2010), it would be interesting for future research to assess differences in coaching behavior during youth athletes' development towards transition related to reflection. Many coaches still have a controlling way of coaching as they feel the urge to excessively help their pupils with everything they can and to explain things over and over again (Mouratidis et al., 2010; Van Ark et al., 2010). In contrast, stimulating athletes to take responsibility for their own learning, supporting them in an autonomous fashion, and encouraging them to self-set goals of improvement specifically towards the moment of transition is suggested to be more effective during talent development, during transition and for attainment of success (MacNamara & Collins, 2010; Mouratidis et al., 2010; Van Ark, et al., 2010). Based on these findings we suggest that coaches need to adapt their coaching behavior to athletes' phases of development (Van Ark et al., 2010), and to involve athletes in early stages of development in this processes of planning and goal-setting as this may favor their reflective thinking. This, however, should be further assessed in future research.

In this perspective, a strong point of the present study is that the development of reflection is related to the athletes' years before transition and not to their chronological age. Though younger athletes are assumed to be less capable of using self-knowledge and past experiences for reflective objectives from a neuro-developmental perspective (Sebastian et al., 2008), this study shows that the importance of using reflective thinking is more strongly related to the developmental phases as determined by the sport. To elaborate, female gymnasts and female swimmers, for example, are forced to have high reflective scores already at the age of 12, whereas a male handball player does not need to possess these levels of reflective thinking before age 17 due to sport-specific differences in transition age (Table 3). The means on reflection of these female gymnasts (4.36 for internationals; 4.05 for nationals), female swimmers (4.35 for internationals; 4.05 for nationals) and male handball players (4.34 for internationals; 4.03 for nationals) underline this proposition as their scores were in line with the total population's mean scores of 4.35 for internationals and 4.05 for nationals, despite the gymnasts and swimmers being 5 years younger that the handball players. In this perspective, it would be interesting to assess the value of taking part in elite sports before the age of 12 as these results suggest that being familiar with the need to reflect may be beneficial for its use at a younger age. Already at age 12 in the case of female gymnasts and swimmers.

Regarding the development of reflection in elite youth athletes, this study has some very interesting and innovative research findings, but weak points as well. We used a self-report measurement. Even though this instrument has shown sufficient reliability and validity measures (Toering et al., in press), it is still a matter for discussion whether people are able to report their cognitions accurately and without being susceptible to socially desirable answers (Eccles, in press). Also, what we know from these results is that senior internationals report they reflected more as juniors. However, what they reflected on and why they chose a specific strategy or action after reflection to improve remains unclear. It would be worthwhile comparing the current reflection scores with more qualitative measures of reflection to validate results and, moreover, to examine what elite youth athletes reflect on exactly. In this perspective, Toering and colleagues (2011) already showed in an exploratory study positive and significant correlations between the SRL–SRS and observations of self-regulative behavior as previously determined by expert coaches in elite youth soccer (Toering, Elferink-Gemser, Jordet, Jorna, Pepping, & Visscher, 2011). Furthermore, although type of sport was not significant, it may be more likely for an athlete to reach the top in one sport compared to another, simply because of the variations in participation levels. We therefore included athletes from the 10 most popular sports in The Netherlands based on participation rates.

This study has practical implications for athletes, trainers, coaches and talent scouts. Although this study does not address questions of causality (i.e., have senior internationals developed their reflective thinking through sport or do they possess an innate ability to reflect), prior research suggests that reflection can be learned and prompted (e.g., Peters & Kitsantas, 2010), and the sport context may be unique for its goal-setting and feedback-oriented character. In this perspective, autonomy-supportive coaching seems most successful (van Ark et al., 2010) as it enhances athletes' feelings of competence and motivation to keep on track and favors athletes' responsibility for their own learning process (MacNamara & Collins, 2010; Mouratidis et al., 2010). It would therefore be interesting to develop instructions for coaches on how to support their athletes to use reflective thinking and how to involve athletes early in their development in the processes of goal-setting and feedback which may favor their reflective thinking. It should be acknowledged that an individual approach to stimulate athletes to use reflective thinking is necessary as there are variations in reflection between athletes (Figure 1a; Table 4), and their strengths and weakness and the goals to improve set accordingly are personal as well. Furthermore, our results may encourage the athletes themselves to recognize the importance of reflective thinking in becoming an international at senior level.

In conclusion

Our results suggest that reflection can assist in predicting the attained senior status of elite youth athletes. Differences in reflective

thinking between the later senior internationals and the senior nationals already exist four years before transition and these differences remain stable in the four-year period towards senior level. Approximately 28% of the elite youth athletes change in competitive level within this four-year period and most of these athletes increase or decrease in competitive level at the moment of transition. A relationship between these changes and athletes' use of reflection has been observed. Reflection consists of different subprocesses that seem to follow a dissimilar developmental pattern. Items related to Zimmerman's (2000) subprocesses of self-evaluation and adaptive inferences appeared most discriminative between the senior internationals and the senior nationals. Based on these results, trainers, coaches and researchers are challenged to develop ways to support elite youth athletes individually to use reflective thinking in order to fulfill their full potential as athletes and to make a successful transition to senior level.

Perspective

The present study is one of the first relating elite youth athletes' levels of reflective thinking at junior age to their senior attained competitive level. Those elite youth athletes who attained senior international status had higher scores on reflection four years before transition, regardless of junior competitive level, number of training hours per week, years of sport experience, age and gender. Furthermore, these differences remained up to the moment of transition to senior level.

This study contributes to existing literature as most prior research with young athletes has been conducted retrospectively (e.g., Durand-Bush & Salmela, 2002), did not adopt a longitudinal research design (e.g., Jonker et al., in press), or did not relate the development of reflection to athletes' developmental phases. Thus, our results extend prior research in a development perspective, but can also assist coaches in predicting the attained senior status of youth athletes. Based on Zimmerman's (2000) subprocesses of self-reflection, self-evaluation and adaptive inferences seem specifically important for attainment of senior internationals status. Furthermore, a rationale for coaches is provided how to stimulate athletes to use reflective thinking by autonomy supportive coaching during their years as juniors and towards the moment of transition to senior level.

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Chapter 10

Measuring self-regulation in a learning context: Reliability and validity of the Self-Regulation of Learning Self-Report Scale (SRL–SRS)

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Abstract

Self-regulation of learning has been suggested to refer to self-directed processes that help individuals learn more effectively. No instrument is available to date examining self-regulation of learning as a relatively stable individual attribute. Therefore, based on Zimmerman's (1989, 2006) self-regulated learning theory, we composed the Self-Regulation of Learning – Self-Report Scale (SRL–SRS), which comprises six subscales: planning, self-monitoring, evaluation, reflection, effort and self-efficacy. This study examined the reliability and validity of the SRL–SRS. Two confirmatory factor analyses were conducted involving 601 and 600 adolescents aged 11 to 17 years (M_{age} = 13.9, SD = 1.3). The first confirmatory factor analysis revealed that an adjusted six-factor model described the observed data and content of factors best, which was cross-validated in the second sample of adolescents. The relative and absolute test-retest reliability was satisfactory. In conclusion, this study showed that the SRL–SRS is a reliable instrument, and supported its content and construct validity.

Keywords: *Self-regulation, learning, adolescent, questionnaire, confirmatory factor analysis, internal consistency, test-retest reliability*

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Introduction

Self-regulation is presumed to involve processes that allow individuals to exert control over their thoughts, feelings, and actions (Baumeister & Vohs, 2004). It enables individuals to adapt to their social and physical environment, and is, therefore, a key process in psychological functioning (Schmeichel & Baumeister, 2004). Self-regulation in the context of learning has been suggested to refer to self-directed processes that give learners the opportunity to transform their mental abilities into performance skills (Zimmerman, 2008). Self-regulated learners are regarded as individuals who proactively rather than reactively approach their learning tasks, meaning that they show personal initiative,

perseverance, and adaptive skills, which originate from favorable metacognitive strategies and motivational beliefs (e.g., Zimmerman, 2006, 2008). Self-regulatory processes have been suggested to not produce high levels of expertise instantly, but to help people acquire knowledge and skills more effectively (Zimmerman, 2006). Therefore, self-regulated learners may get more out of their potential, irrespective of the learning domain. For instance, self-regulation has been found to be positively related to performance and skill level in different domains, such as sports, music, and academic achievement (e.g., Anshel & Porter, 1996; Cleary & Zimmerman, 2001; Kirschenbaum, Ordman, Tomarken & Holtzbauer, 1982; Kitsantas & Zimmerman, 2002; Nielsen, 2001; Nota, Soresi & Zimmerman, 2004; Pintrich & De Groot, 1990; Schunk, 2005).

Hence, the tendency of taking a proactive approach to learning, that is self-regulation of learning, may be related to achievement in multiple domains. Youth elite athletes, for example, were found to be high academic achievers as well and self-regulation of learning could be one of the factors underlying this finding (Jonker, Elferink-Gemser, & Visscher, 2009). To measure self-regulation of learning as a relatively stable feature of an individual in multiple domains, we need an instrument that assesses self-regulation of learning as a disposition. However, the self-report instruments available to date measure self-regulation of learning domain-specifically (e.g., Pintrich, Smith, Garcia, & McKeachie, 1993; Weinstein, Schulte, & Palmer, 1987; Zimmerman & Martinez-Pons, 1986, 1988). The lack of an instrument measuring general self-regulation of learning lead us to develop a self-report instrument based on self-regulated learning theory (Zimmerman, 1989, 2006), that aims to examine self-regulation of learning as a relatively stable attribute of an individual.

It is evident that learning is important for performance improvement, but learning can also play a role in enhancing levels of physical activity. Following the self-enhancement hypothesis, human beings intend to maximize positive feelings or effectively master challenging tasks (e.g., Deci & Ryan, 2002; Fox & Wilson, 2008; Nicholls, 1989). Self-regulation of learning can contribute to individuals' perceived competence and expectations for success by increasing their ability in a more effective manner (e.g., Zimmerman, 2006). An instrument measuring self-regulation of learning may identify individuals' strengths and weaknesses with respect to learning. This information could be used to help people learn more effectively, which in turn may lead to, for instance, improvements in sport performance or higher physical activity levels through feelings of task mastery.

Self-regulated learners want to improve and in order to reach this goal, they must know which performance aspects need improvement and how this can be accomplished. It has been suggested that individuals who self-regulate well must: a. *Plan* how to approach a task in advance of their actions, b. *Self-monitor* their improvement during task performance, c. *Evaluate* the process and outcome after the execution of their plan, and d. During cycles of planning, self-monitoring, and evaluation, *reflect* upon the learning process, meaning that they put their knowledge into action and increase the number of strategies they can use, which gives them more possibilities to approach and perform future tasks (Ertmer & Newby, 1996).

It has been assumed that, besides knowing what aspects to improve and how to improve these aspects, self-regulated learners must be motivated to improve (Zimmerman, 1989, 2006). Self-regulated learning research among students revealed that motivational outcome variables (e.g., effort) and motivational beliefs (e.g., self-efficacy) were positively linked to cognitive and metacognitive strategy use (e.g., Pintrich & Schunk, 2002; Schunk, 2001). Ericsson, Krampe, and Tesch-Römer (1993) stated that individuals must be willing to invest maximal efforts to improve and sustain these efforts over years in order to reach optimal levels of performance. Bandura (1997) suggested that individuals must believe that they can successfully cope with task requirements in order to be motivated to execute tasks, which is referred to as self-efficacy. Self-efficacy beliefs are thought to determine the goals individuals set for themselves, how much effort they invest, their perseverance, and their resilience to failure (Bandura, 1993). Thus, effort and self-efficacy were included as the motivational variables of self-regulation of learning.

The Self-Regulation of Learning – Self-Report Scale (SRL–SRS) we composed contains 50 items and is intended to measure self-regulation as a relatively stable attribute in multiple learning domains, such as sports, music, and school. The SRL–SRS comprises subscales of originally English-language questionnaires (Herl et al., 1999; Hong & O'Neil Jr., 2001; Howard, McGee, Shia & Hong, 2000; Peltier, Hay & Drago, 2006; Schwarzer & Jerusalem, 1995). The SRL–SRS subscales are planning, self-monitoring, evaluation, reflection, effort, and self-efficacy.

The purpose of the current study was to examine the reliability and validity of the SRL–SRS among adolescents aged 11 to 17 years. First, a confirmatory factor analysis was executed to determine whether the hypothesized six-factor model fitted the observed data. The model that fitted the data best was cross-validated within another group of same-age adolescents. Second, the relative and absolute test-retest reliability, and the longitudinal measurement invariance were assessed.

Method

Participants

Confirmatory factor analysis

A sample of 1,201 participants aged 11 to 17 years, which was randomly divided into two samples with equal proportions of boys and girls, was included in the confirmatory factor analysis (CFA). The participants were Dutch secondary school students from prevocational and pre-university academic levels with a mean age of 13.9 years (*SD* = 1.3). Six-hundred-and-one adolescents aged 11 to 17 years (308 boys and 293 girls) were included in the first CFA (M_{age} = 13.9, SD = 1.3). The second, validation sample consisted of 308 boys and 292 girls of the same age (M_{age} = 13.9, SD = 1.3).

Test-retest reliability

To determine test-retest reliability, the questionnaire was administered twice to a randomly selected subpopulation of 290 adolescents aged 11 to 17 years (146 boys and 144 girls) with a mean age of 13.9 years (*SD* = 1.3). The time interval between the first and second assessments of the SRL–SRS was four to six weeks. This interval was considered long enough to reduce the chance of

participants remembering the answers they gave when they completed the SRL–SRS for the first time, and short enough to reduce the chance that confounding factors could interfere, as the SRL–SRS is a dispositional measure (e.g., Kawabata, Mallett, & Jackson, 2008).

Procedure

Participants were recruited from secondary schools in the Netherlands. The governing bodies of the schools which the adolescents attended and their parents were approached in writing. Prior to participation, the governing bodies of the schools and the parents gave their written consent. Participants completed the SRL–SRS individually in a group setting with one of three test leaders present. Test leaders instructed the participants following a protocol that was agreed upon beforehand. Completion of the questionnaire took the students approximately 30 minutes. The procedures were in accordance with the ethical standards of the Medical Faculty of the University of Groningen.

Instrument

The subscales of planning and effort were based on the self-regulatory inventory by Hong and O'Neil Jr. (2001), and the self-monitoring subscale was adopted from the Self-Regulation Trait Questionnaire by Herl and colleagues (1999). Self-efficacy was assessed with items based on the Generalized Self-efficacy Scale (Hong & O'Neil Jr., 2001; Schwarzer & Jerusalem, 1995). The evaluation items were adopted from the evaluation subscale of the Inventory of Metacognitive Self-Regulation (Howard et al., 2000), and the reflection subscale was based on the reflection subscale of the Reflective Learning Continuum (Peltier et al., 2006). In the original reflection subscale, items were written in the past simple tense, which we changed into the present simple tense for purposes of the current study.

The subscales of planning (9 items), self-monitoring (8 items), effort (10 items), and self-efficacy (10 items) were scored on a 4-point Likert rating scale: *(1) almost never* to *(4) almost always*. The subscales of evaluation (8 items) and reflection (5 items) were scored on a 5-point Likert rating scale. In accordance with the original scales, evaluation ranged from *(1) never* to *(5) always*, and reflection ranged from *(1) strongly agree* to *(5) strongly disagree*. Before data analysis, reflection scores were reversed to make them correspond to the scores on the other five subscales.

Instrument Adaptation

The instrument was translated into Dutch, followed by a back-translation procedure (e.g., Duda & Hayashi, 1998; Kawabata et al., 2008; Tanzer & Sim, 1999). First, two bilingual individuals translated the items from English into Dutch. These translations were translated back from Dutch into English without the help of the original scale by two other, independent individuals, who were proficient in both languages. Thereafter, the translators and their supervisor (professor in human movement sciences) examined the translations of all items and some minor linguistic modifications were made in order to maintain the intended meaning of the items.

This version of the SRL–SRS was pilot tested within a group of 48 adolescents of the same age as the target population. Participants were asked to mark the words or phrases they found difficult to understand. Then, in order to make the questionnaire comprehensible to the youngest participants in the study, seven small linguistic modifications were made, which resulted in the final draft of the SRL–SRS. For example, we changed the original item of 'I am willing to do extra work on tasks to improve my knowledge' into 'I am willing to do extra work on tasks in order to learn more', because participants indicated that they had difficulties understanding the phrase 'to improve knowledge'.

Data Analysis

The amount of missing data was below 5% in each sample and the data were randomly missed. Cases with more than 5% missing data (n = 52) were removed from the analysis, which resulted in the total number of participants of 1,201. Missing values were replaced using a missing values analysis with maximum likelihood estimation, because this method takes all scores on a certain subscale into account when replacing missing values (e.g., Acock, 2005). The distributional assumptions of normality were not violated.

Confirmatory factor analysis

To determine whether the hypothesized six-factor model fitted the observed data, a CFA was performed among the first sample of adolescents (n = 601) in LISREL 8.51 (Jöreskog & Sörbom, 2001). A correlation matrix was analyzed and a maximum likelihood method of estimation was employed. A model allowing free loadings on the items within each of the six hypothesized factors, postulated by the theory, was tested. Factor variances were fixed at unity, meaning that standardized values were calculated, and all factors were allowed to correlate freely. In addition, the unexplained variances of all items were estimated (theta-delta diagonal). After adjustments were made, the new model was cross-validated within the second sample of adolescents (n = 600).

The model fit was assessed with the χ^2 statistic, comparative fit index (CFI; Bentler, 1990), non-normed fit index (NNFI; Bentler & Bonett, 1980), root mean square error of approximation (RMSEA; Steiger, 1990), and standardized root-mean square residual (SRMR; Hu & Bentler, 1999). The χ^2 statistic indicates how well a model fits the observed data and should have a value over .05. However, the non-significant χ^2 statistic is associated with sample size (Jöreskog & Sörbom, 1993), and is therefore considered an overstringent criterion (Bentler, 1990). Values for CFI and NNFI should exceed .90 to indicate an acceptable fit to the data (Byrne, 1998; Hu & Bentler, 1999). The RMSEA is one of the most informative criteria in covariance structure modeling, and takes into account the error of approximation (Byrne, 1998). Values below .05 indicate a good fit, while values up to .08 indicate reasonable errors of approximation in the population (Jöreskog & Sörbom, 1993). The SRMR shows the difference between the observed and predicted covariance, and has a criterion value of < .08 (Byrne, 1998; Hu & Bentler, 1999). A two-index strategy to decide whether a model should be rejected was proposed by Hu and Bentler (1999), stating that a model should be rejected when (a) NNFI or CFI is below .95 and (b) SRMR is above .09 (or .10). As they as well as several others have cautioned about overgeneralization of these findings (e.g., Fan & Sivo, 2005; Kawabata et al., 2008), we decided to use multiple conventional criteria (i.e., CFI and NNFI > .90, RMSEA < .08, SRMR< .08). Furthermore, the factor loadings were tested for significance using a significance level of .05, and loadings should be at least .40 (e.g., Martens & Webber, 2002; Mullan, Markland, & Ingledew, 1997). The explained variance of each item was also as-

sessed.

The Modification Indices for lambda x and theta-delta were examined to find out whether certain changes could improve the model fit. A Modification Index (MI) is the reduction in the χ^2 statistic, if the relationship between certain items is set free. The MIs for lambda x show if allowing variables to cross-load on a non-intended factor can improve the model fit, whereas the MIs for theta-delta indicate whether certain items share unexplained variance.

The internal consistency of the scale was determined by computing Cronbach's α coefficients, which have a criterion value of > .70 (Nunnally, 1978). The "if item deleted" option was used to determine the effect of removing items from a subscale. Furthermore, the inter-item correlations were calculated and the inter-scale correlations were examined. Inter-item correlations should be positive, and inter-scale correlations should not exceed a value of .80 (Carron, Widmeyer, & Brawley, 1985).

Test-retest reliability

Temporal stability of the SRL–SRS was examined by determining the relative and absolute test-retest reliability, and the longitudinal measurement invariance. Relative test-retest reliability is the extent to which individuals maintain their rank in a sample with repeated measurements. The relative test-retest reliability was examined by performing one-way random consistency analyses of variance to compute average measures Intraclass Correlation Coefficients (ICCs) of repeated measures. For all ICCs, 95% confidence intervals were calculated (Rankin & Stokes, 1998), and ICCs should have a value of at least .70 (Litwin, 1995).

Absolute test-retest reliability indicates how the scores on repeated tests vary for individuals, without regard to the individual's rank in a sample (Atkinson & Nevill, 1998, 2001). The mean difference between the first and second measurements was taken as a measure of absolute test-retest reliability. One-sample *t* tests with a significance level of .05 were performed to find out whether the difference between measurements differed from zero. The measurements were considered unbiased if the *t*-test results were non-significant.

A longitudinal measurement invariance analysis using a single-group approach was performed to examine the equality of factor structure for the SRL–SRS over time. A covariance matrix was analyzed and a maximum likelihood method of estimation was employed. Factor variances were estimated and all factors were allowed to correlate freely with each other. In addition, the unexplained variances of all items were specified (theta-delta diagonal). The intercepts the latent factor means were estimated, and the standardized solutions were interpreted. To examine the equality of factor loadings over time, a second longitudinal measurement invariance analysis following similar procedures was performed with the restriction that factor loadings were equal at test and retest times. Additionally, models were examined with equal intercepts and error variances, respectively (e.g., Brown, 2006).

Results

Confirmatory Factor Analysis

The goodness of fit indices for the CFAs are presented in Table 1. The first CFA indicated an acceptable model fit, but inspection of the MIs, factor loadings and explained variances revealed that the model could be improved. The MIs for lambda x showed that, if item 39 (effort) would be allowed to cross-load on the self-efficacy factor, the model fit would improve, and that this item's estimated factor loading would be above .40. Moreover, adding item 39 to the self-efficacy subscale improved the Cronbach's α of this scale from .79 to .81, while the internal consistency of the effort subscale was not reduced. Whether transposing item 39 to the self-efficacy subscale was theoretically plausible, is treated in the Discussion section.

Furthermore, factor loadings and explained variances of items 3, 10, 14, and 42 were low. The MIs for lambda x showed that transposing these items would not improve the model fit. The "if item deleted" option indicated that removing items 3, 10, 14, and 42 would not significantly decrease the internal consistency of the planning, self-monitoring, and effort subscales. Hence it was decided to remove these items from the SRL–SRS.

When items 3, 10, 14, and 42 were removed and item 39 was transposed, the MIs for theta-delta showed that there was a high correlation between the unexplained variances of items 5 and 2. Therefore, setting free theta-delta (5,2) would improve the model fit considerably (MI = 124.39). Setting free theta-delta (8,6), theta-delta (34,31), and theta-delta (43,41), which had an MI of 62.51, 109.01, and 50.23, respectively, also improved the fit of the model considerably.

As can be seen in Table 1, the adjustments made produced a better model fit. The factor loadings of the adjusted six-factor model were all statistically significant (t > 2.00), differing from .47 to .77 (Appendix 1). The phi-values were all positive and ranged from .44 to .80 (Table 2).

Table 1. Goodness of Fit Statistics of the Different Models for the First Sample (n = 601) and Validation Sample (n= 600).

	χ^2	*df*	CFI	NNFI	RMSEA	RMSEA (90% CI)	SRMR
First Sample							
Six-factor model	4077.85	1160	.93	.93	.066	[.063, .068]	.071
Six-factor adjusted model	3067.51	970	.95	.94	.060	[.058, .063]	.063
Five-factor adjusted model	3257.34	976	.94	.94	.063	[.061, .066]	.063
Validation Sample							
Six-factor adjusted model	3193.70	970	.95	.95	.061	[.059, .064]	.061

Note. CFI = comparative fit index; NNFI = non-normed fit index; RMSEA = root mean square error of approximation; 90% CI = 90% confidence interval; SRMR = standardized root mean residual.

Table 2. Phi-valkues of the SRL-SRS subscales for the Adjusted Six-Factor Model.

	1	2	3	4	5	6
Planning	-					
Self-monitoring	.67*	-				
Evaluation	.65*	.80*	-			
Reflection	.46*	.48*	.58*	-		
Effort	.53*	.67*	.58*	.32*	-	
Self-efficacy	.51*	.46*	.48*	.30*	.50*	-

* $P < .05$

Table 3. Means and Standard Deviations before CFA, Cronbach's α Coefficients before and after CFA, and Inter-Scale Correlations after CFA (n = 601).

	M	*SD*	Cronbach's α before CFA	Cronbach's α after CFA	1	2	3	4	5	6
1. Planning	2.41	0.51	.81	.81	-					
2. Self-monitoring	2.50	0.52	.73	.73	.54*	-				
3. Evaluation	3.32	0.57	.82	.82	.55*	.63*	-			
4. Reflection	3.73	0.59	.78	.78	.44*	.40*	.48*	-		
5. Effort	2.66	0.52	.85	.85	.46*	.57*	.56*	.34*	-	
6. Self-efficacy	2.73	0.45	.79	.81	.44*	.44*	.45*	.34*	.49*	-

* $P < .01$

Table 4. Test-Retest Statistics for the SRL-SRS Subscales.

	M t_1 (*SD*)	*M* t_2 (*SD*)	t_1-t_2	*SE* of t_1-t_2	95% CI for t_1-t_2	ICC	95% CI for ICC
Planning	2.34 (0.46)	2.35 (0.47)	-0.01	0.03	[-0.04, 0.07]	0.70	[0.62, 0.76]
Self-monitoring	2.47 (0.47)	2.48 (0.47)	-0.01	0.03	[-0.06, 0.04]	0.69	[0.61, 0.75]
Evaluation	3.33 (0.51)	3.37 (0.49)	-0.04	0.03	[-0.08, 0.01]	0.80	[0.75, 0.84]
Reflection	3.72 (0.52)	3.68 (0.48)	0.04	0.03	[-0.01, 0.10]	0.74	[0.67, 0.79]
Effort	2.61 (0.45)	2.56 (0.48)	0.05	0.03	[0.09, 0.21]	0.84	[0.80, 0.88]
Self-efficacy	2.70 (0.41)	2.68 (0.38)	0.02	0.03	[-0.12, -0.01]	0.80	[0.74, 0.85]

Note. t_1 - t_2 = mean difference between scores on the first and second testing time; SE of t_1 - t_2 = Standard Error of the mean difference; 95% CI for t_1 - t_2 = 95% Confidence Interval for the mean difference; ICC = Intraclass Correlation Coefficient; 95% CI for ICC = 95% Confidence Interval for Intraclass Correlation Coefficient.

Because of the high phi-value between the subscales of self-monitoring and evaluation we also tested an alternative model with five factors. Adjustments to this model were made following the same procedures as the previously described six-factor model. However, results revealed that a five-factor model with some significant changes did not produce significantly better results than the six-factor model postulated by theory (see also Table 1). Therefore, it was decided to use the adjusted six-factor model for further validation. In Table 1 the results of the CFA among the second sample of adolescents (n = 600) are presented. The validation CFA produced a good fit and factor loadings were all statistically significant, supporting the validity of the SRL–SRS.

Internal Consistency

Table 3 shows means, standard deviations, the Cronbach's α coefficients of the six subscales before and after model adjustment, and the inter-scale correlations after model adjustment. All Cronbach's α coefficients were higher than the criterion of .70, indicating sufficient internal consistency. The inter-item correlations for planning ranged between .21 and .59, for self-monitoring between .16 and .42, for evaluation between .24 and .53, for reflection between .35 and .49, for effort between .26 and .55, and for self-efficacy between .15 and .51, meaning all inter-item correlations were positive. As can be seen in Table 4, the inter-scale correlations were positive as well and did not exceed .80 (r = .34-.63).

Test-Retest Reliability

The ICCs varied between .69 and .84 (Table 4), meaning that all subscales had a sufficient relative temporal stability, except the self-monitoring scale. In addition, Table 4 indicates that the mean differences between both measurements for the subscales were non-significant, except for effort and self-efficacy. Therefore, the absolute temporal stability could be considered acceptable for planning, self-monitoring, evaluation, and reflection. Although effort and self-efficacy did not meet the criterion for satisfactory absolute temporal stability, the mean differences between both measurements of 0.05 and 0.02, respectively, were small and may, therefore, be deemed irrelevant.

Table 5. Fit Indices of the Longitudinal Measurement Invariance Analysis (n = 290).

	χ^2	*df*	*p*	$\Delta\chi^2$	Δdf	*p*	RMSEA (90% CI)	SRMR	CFI	NNFI
Equal factor structure over time	9167.11	4020	< .001				[.057, .061]	.094	.90	.90
Equal factor loadings over time	9806.51	4060	< .001	639.40	40	< .001	[.063, .066]	.107	.89	.89
Equal intercepts over time	9806.51	4100	< .001	0.00	40	> .05	[.062, .067]	.107	.89	.89
Equal error variances over time	14564.04	4150	< .001	4757.53	50	< .001	[.071, .074]	.129	.80	.80

Note. RMSEA = root mean square error of approximation; 90% CI = 90% confidence interval; SRMR = standardized root mean residual; CFI = comparative fit index; NNFI = non-normed fit index.

Discussion

Based on Zimmerman's theory of self-regulated learning (1989, 2006), we composed an instrument (the SRL–SRS) measuring self-regulation of learning as a disposition. The purpose of the current study was to examine the reliability and validity of the SRL–SRS, which contained the subscales of planning, self-monitoring, evaluation, reflection, effort, and self-efficacy. A CFA among 601 adolescents indicated that an adjusted six-factor model fitted the data acceptably. This model was validated within a second sample of 600 adolescents reproducing the results of the first CFA, thus supporting the validity of the SRL–SRS. Furthermore, inspection of the inter-item correlations, Cronbach's α coefficients, and inter-scale correlations revealed that the internal consistency of the subscales was sufficient. In addition, the relative and absolute test-retest reliability were examined, and results showed that the temporal stability of the SRL–SRS was sufficient as well.

The CFA indicated that a six-factor model fitted the data acceptably. Inspection of the results showed that allowing item 39 (effort) to load on the subscale of self-efficacy could improve the model fit and factor loadings considerably. Self-efficacy was defined as an individual's belief that he or she can successfully execute the behavior demanded to successfully perform a certain task (Bandura, 1997). We examined the content of item 39 (*'If I persist on a task, I'll eventually succeed'*) and compared this with the other self-efficacy items. Item 39 seemed to resemble the content of items 46 and 48 (item 46: *'I always manage to solve difficult problems if I try hard enough'*; item 48: *'I can solve most problems if I invest the necessary effort'*). We decided that putting item 39 into the self-efficacy subscale would be plausible on theoretical grounds, because it involved a sense of being confident to manage the requirements of a task. Therefore, the replacement of item 39 from the effort into the self-efficacy subscale was considered appropriate on statistical and theoretical grounds.

The content validity of the SRL–SRS was supported by the fact that our model drew upon Zimmerman's theory (1989, 2006). Four out of six subscales were adopted and adapted from scales that were originally developed in line with this theory (e.g., Hong & 'O Neil Jr., 2001). Furthermore, all items were checked by three of the authors (experienced in self-regulation theory) on their relevance for measuring self-regulation of learning as a relatively stable individual characteristic. During the translation process, the translators and their supervisor also controlled whether the content of the items was stated as intended. Participants in the pilot test were asked to mark the words they found difficult, to ensure the items were intelligible to the target sample. This team approach strengthened the linguistic equivalence in the translation process (e.g., Kawabata et al., 2008; Tanzer & Sim, 1999). In accordance with the results of the first CFA, several adjustments were made that improved the model fit and increased factor loadings and explained variance, thereby increasing the content validity. The CFA results were considered fairly good, because due to the complexity of the model it would not be realistic to expect an excellent model fit. The validation CFA also showed that the results were stable over different samples, which supported the content validity of the SRL–SRS.

The construct validity of the scale was supported by the results of the CFA, because the model postulated by the theory fitted the data acceptably. The subscales were significantly correlated, which indicates that all six aspects were linked to the same construct of self-regulation of learning. However, self-monitoring and evaluation could be measuring the same construct, since their phi-value exceeded .80. For this reason, a five-factor model was also tested, but results revealed that this model did not produce a significantly better model fit than the six-factor model postulated by the theory. Moreover, the inter-scale correlation between self-monitoring and evaluation did not exceed .80 (i.e., r = .63). The difference between the phi-values and the inter-scale correlations is that phi-values account for the variance explained by the items within a factor, whereas in the calculation of inter-scale correlations all scales are equally weighed. Additionally, the high correlation between self-monitoring and evaluation is in line with self-regulated learning theory. The aspects of planning, self-monitoring, and evaluation were most highly related, that is, correlations were highest among these three subscales. As these subscales also are supposed to represent the three phases in the self-regulated learning process (e.g., Cleary & Zimmerman, 2001; Ertmer & Newby, 1996; Zimmerman, 2006, 2008), the results support the construct validity of the model.

The SRL–SRS subscales were relatively and absolutely stable over time, indicating that the SRL–SRS can be used as an instrument to measure self-regulation of learning as a disposition. Only the ICC for self-monitoring was slightly below the criterion value, which indicates that this subscale may lack some relative stability. However, the relative stability of the other subscales was sufficient. The effort and self-efficacy subscales did not meet the criterion for absolute test-retest reliability, but the differences in effort and

self-efficacy between both measurements were too small to be considered relevant. The power of 93.0% showed that, with a smaller sample size, the differences in effort and self-efficacy would probably be non-significant, meaning that the differences between both measurements were small enough to state that the SRL–SRS has an acceptable absolute temporal stability. Therefore, the relative and absolute test-retest reliability of the SRL–SRS was considered sufficient, meaning that the SRL–SRS can be considered to measure self-regulation of learning as a disposition. Furthermore, an initial step was taken to examine the longitudinal measurement invariance of the SRL–SRS. The factor structure seemed to be equal over time, while factor loadings, intercepts, and error variances varied over time. The LISREL program indicated, however, that the relatively small number of participants in relation with the complexity of the model may have influenced the reliability of the results. The equal χ^2 values of the model with factor loading and intercept restrictions, respectively (see Table 5), seem to confirm that our model may have been too complex for this type of analysis. We therefore cannot draw definite conclusions about the equality of the SRL–SRS factor structure over time and recommend to repeat the longitudinal measurement invariance analysis with a larger sample.

Another recommendation for further research is to examine the validity of the SRL–SRS more extensively by, for instance, examining the predictive validity. To make the scores on the SRL–SRS subscales more meaningful in real-world terms and therefore more valid, it would be interesting to relate the SRL–SRS scores to actual behavior. Behavioral correlates of self-regulation of learning in sport are expected to differ from those in academic achievement (e.g., Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002; Perry, 1998; Young & Starkes, 2006a, 2006b). Behavioral correlates of self-regulation of learning may even differ between different sports and between different academic courses. Therefore, domain-specific observational instruments should be developed in order to measure behavioral correlates of self-regulation of learning, so that it can be determined whether the SRL–SRS can predict these kinds of behavior. Another implication to more extensively examine predictive validity is to find out whether the SRL–SRS can predict actual learning, because SRL–SRS scores may be related to the progress individuals make in a certain domain. Although within-network properties of the SRL–SRS have been thoroughly examined in the current study, between-network data were not collected, which is considered a limitation. It would be interesting to examine the relationship between the SRL–SRS and other constructs hypothesized to be theoretically related. Future research should address this issue.

In conclusion

This study indicated that the SRL–SRS is a reliable instrument to measure self-regulation of learning as a relatively stable attribute. Moreover, the study provided support for the content and construct validity of the instrument. However, the current study also had some limitations, which should be addressed in future research, such as to more thoroughly examine the validity of the SRL–SRS. A recommendation for future research is to measure behavioral correlates of self-regulation of learning and examine the relationship of the SRL–SRS with actual learning in order to determine the predictive validity of the SRL–SRS. Combined with the SRL–SRS, behavioral correlates could give a good indication of individuals' self-regulation with respect to learning in a specific domain.

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Appendix 1. Factor Loadings and Explained Variance (R2) of the SRL-SRS Items.

		Planning	Self-monitoring	Evaluation	Reflection	Effort	Self-efficacy	R^2
1.	I determine how to solve a problem before I begin.	.48						.22
2.	I think through in my mind the steps of a plan I have to follow.	.55						.30
3.	I try to understand the goal of a task before I attempt to answer.*	.38						.14
4.	I ask myself questions about what a problem requires me to do to solve it, before I do it.	.66						.44
5.	I imagine the parts of a problem I still have to complete.	.66						.44
6.	I carefully plan my course of action to solve a problem.	.68						.46
7.	I figure out my goals and what I need to do to accomplish them.	.55						.31
8.	I clearly plan my course of action to solve a problem.	.74						.55
9.	I develop a plan for the solution of a problem.	.76						.57
10.	While doing a task, I ask myself questions to stay on track.*		.41					.17
11.	I check how well I am doing when I solve a task.		.56					.48
12.	I check my work while doing it.		.65					.43
13.	While doing a task, I ask myself, how well I am doing.		.62					.39
14.	I know how much of a task I have to complete.*		.43					.19
15.	I correct my errors.		.50					.25
16.	I check my accuracy as I progress through a task.		.66					.44
17.	I judge the correctness of my work.		.63					.40
18.	I look back and check if what I did was right.			.73				.53
19.	I double-check to make sure I did it right.			.69				.48
20.	I check to see if my calculations are correct.			.57				.32
21.	I look back to see if I did the correct procedures.			.67				.45
22.	I check my work all the way through the problem.			.69				.47
23.	I look back at the problem to see if my answer makes sense.			.67				.45
24.	I stop and rethink a step I have already done.			.60				.36
25.	I make sure I complete each step.			.50				.25
26.	I reappraise my experiences so I can learn from them.				.66			.44
27.	I try to think about my strengths and weaknesses.				.72			.51

	Planning	Self-monitoring	Evaluation	Reflection	Effort	Self-efficacy	R^2
28. I think about my actions to see whether I can improve them.				.72			.52
29. I think about my past experiences to understand new ideas.				.62			.39
30. I try to think about how I can do things better next time.				.70			.49
31. I keep working even on difficult tasks.					.58		.33
32. I put forth my best effort when performing tasks.					.70		.48
33. I concentrate fully when I do a task.					.64		.40
34. I don't give up even if the task is hard.					.55		.31
35. I work hard on a task even if it is not important.					.76		.58
36. I work as hard as possible on all tasks.					.77		.60
37. I work hard to do well even if I don't like a task.					.74		.55
38. If I'm not really good at a task I can compensate for this by working hard.					.63		.40
39. If I persist on a task, I'll eventually succeed.				(.39)	.56		.31
40. I am willing to do extra work on tasks in order to learn more.				.64			.41
41. I know how to handle unforeseen situations, because I can well think of strategies to cope with things that are new to me.					.53		.28
42. If someone opposes me, I can find means and ways to get what I want.*					.34		.11
43. I am confident that I could deal efficiently with unexpected events.					.54		.29
44. If I am in a bind, I can usually think of something to do.					.54		.30
45. I remain calm when facing difficulties, because I know may ways to cope with difficulties.					.62		.39
46. I always manage to solve difficult problems if I try hard enough.					.71		.50
47. It is easy for me to concentrate on my goals and to accomplish them.					.50		.25
48. I can solve most problems if I invest the necessary effort.					.74		.54
49. When I am confronted with a problem, I usually find several solutions.					.60		.36
50. No matter what comes my way, I'm usually able to handle it.					.56		.31

Note. All factor loadings were statistically significant ($t > 2.00$). The planning subscale was based on the *Self-Regulatory Inventory* by Hong and O'Neil Jr. (2001), the self-monitoring subscale was based on the *Self-Regulation Trait Questionnaire* by Herl and colleagues (1999), the evaluation subscale was based on the *Evaluation* subscale of the *Inventory of Metacognitive Self-Regulation* by Howard and colleagues (2000), the reflection subscale was based on the *Reflection* subscale of the *Reflective Learning Continuum* by Peltier and colleagues (2006), the effort subscale was based on the *Self-Regulation Trait Questionnaire* by Herl and colleagues (1999), and the self-efficacy subscale was based on the *Generalized Self-efficacy Scale* by Schwarzer & Jerusalem (1995).
* Item removed from the SRL-SRS.

Chapter 11

General discussion and conclusion

General discussion and conclusion

Purpose of the thesis

This thesis has focused on self-regulatory skills in 12-to-18-year-old youth in sports and academia. Comparisons are made between elite youth athletes, regional athletes and non-athletes in the pre-university or pre-vocational systems. Furthermore, insight is provided about the self-regulatory skills that are most frequently used by the best athletes (i.e., junior internationals) and whether this use may predict future competitive level at senior level. The results are based on cross-sectional and longitudinal data, and conclusions and practical implications are outlined for junior internationals and junior nationals striving for the top in their sport, and for regional athletes and non-athletes on how to develop and use their self-regulatory skills in an effective manner.

Self-regulatory skills, sport and academic performances

Despite the prevailing old stereotype that elite youth athletes are low academic achievers, and which still applies to professional soccer players, the results of chapters 3 and 5 show that Dutch elite youth athletes, including soccer players, referred to as elite youth athletes, actually perform better at school than the national average of students in the Netherlands. Chapters 4 and 5 suggest that elite youth athletes may have benefitted from their increased use of self-regulatory skills as a consequence of being active in sports, and that this may also further their academic performance. Self-regulative learners are considered to approach their learning process proactively by setting attainment goals to learn and improve.

Elite youth athletes are considered to be highly familiar with the cognitive construct of self-regulation (Cleary & Zimmerman, 2001) as they work on their athletic improvement every day in an environment in which they have to set attainment goals and which is rich in feedback. Goal-setting and feedback are considered to be important conditions related to the development of self-regulatory skills (Boekaerts & Corno, 2005; Pintrich & Zusho, 2002). The results of chapters 4 and 5 may underline this proposition as the pre-vocational elite youth athletes display similar scores on self-monitoring and evaluation, and sometimes even higher scores on reflection and effort, than pre-university peers who are not identified as being elite youth sports players.

The sports context is also considered to be an optimum environment where regular youth can develop their self-regulatory skills and benefit from the aspects of goal-setting and feedback as well. In sports, athletes learn from an early age to set short- and long-term attainment goals or to reach the goals set by the coach. In academia, on the other hand, an above average number of students have difficulty with self-regulation (Veenman, Kok, & Blöte, 2005). Although it is suggested that those students who are able to recognize the most important material to be learned are more successful (Martín, Martínez-Arias, Marchesi, & Pérez, 2008), most students have trouble deciding what is the most important material to learn. Furthermore, their learning process seems more covert. This means that the feedback provided by the teacher

is more often absent or delayed and based on the performance outcome, for example expressed in grades. It is therefore no exception for students to state that they have learned *everything* and not understand why they fail. By using self-regulatory skills, students seem better able to recognize the most important parts of the study material, and to match these demands to their own strengths and weaknesses instead of learning everything mindlessly (Martín et al., 2008). Prior research showed that students successful in terms of academic level, grades, repeating a class and graduation rates displayed more frequent use of self-regulatory skills (chapters 4 and 5; Nota, Soresi, & Zimmerman, 2004; Zimmerman, 2002). Although recent intervention studies showed positive effects of the interventions (e.g., Cleary, Platten, & Nelson, 2008; Peters & Kitsantas, 2010), we propose that developing self-regulatory skills in academia is more difficult than in the sports domain. The results of chapter 6 support this suggestion as, regardless of the level at which sport is played, 12-to-17-year-old athletes who spend close to six hours a week on training reveal an increased use of self-monitoring and self-efficacy, and were making more effort to learn. An increased use of reflection is already observed in those who spend close to three hours a week on sports. In this perspective, it can be proposed that training at a young age can be considered a learning process. According to Côté (1999), the main focus of youth athletes' training activities is on the development of new skills.

Although we suggest that athletes may profit from their participation in sports due to an increased opportunity to develop self-regulatory skills that can be applied within the academic setting as well, we should acknowledge that there is much discussion in the literature regarding possibilities for successful transfer (e.g., Brainerd, 1975; De Corte, 2003; Perkins & Salomon, 1989; Veenman & Spaans, 2005). According to the broader conception of transfer of skills, namely that knowledge, skills and motivation acquired in one domain further the use of skills in another domain, people in general are expected to be able to use their self-regulatory skills between domains from approximately 12 years of age (Veenman & Spaans, 2005; Zelazo & Müller, 2002). From an early age of approximately 2 to 6 years old, children are expected to start developing domain-specific self-regulatory skills (Alexander, Carr, & Schwanenflugel, 1995; Zelazo & Müller, 2002). It would therefore, be interesting to assess whether elite youth athletes, or athletes who train a substantial number of hours per week, have an increased ability to use domain-specific self-regulation before they reach the age of 12. It should, be pointed out that neuro-developmental factors may play a part as prior research has reported that the medial prefrontal cortex, which is related to the ability to self-regulate, matures relatively late in adolescence (Sebastian, Burnett, & Blakemore, 2008).

Although we have observed that increased levels of self-regulation are related to academic performance (chapters 4 and 5), and that athletes in the present study are considered to be able to transfer their self-regulatory skills between domains (Van der Stel & Veenman, 2008; Veenman et al., 2005), an interesting discussion is related to whether intellectual ability in sports differs from intellectual ability at school. In the literature, there are many concepts and definitions of intellectual ability as well as discussion about whether self-regulatory skills should be considered as part of intellectual ability, either as

entirely independent aspects or correlated, but both make their own contribution to learning as well (Veenman & Spaans, 2005; Veenman et al., 2005). Even though we are not able to draw conclusions based on the results of this thesis, it seems that intellectual ability in sports is considered to be related to cognitive processes such as tactical skills, decision-making (Del Villar, Gonzalez, Iglesias, Moreno, & Cervello, 2007; Kannekens, Elferink-Gemser, & Visscher, e-pub ahead of print; Vaeyens, Lenoir, Williams, & Philipaerts, 2007), and the ability to reappraise knowledge and experience, recognize personal strengths and weaknesses, and to set personal improvement goals accordingly (chapters 6 to 9). Prior research at school showed that both intellectual ability, measured as the combination of inductive and deductive reasoning ability, visuospatial ability and memory ability, and self-regulatory skills make their own unique contribution to learning performance (Veenman & Spaans, 2005). However, those students who know themselves well when it comes to how they approach learning and those who are better able to derive the main ideas from the information to be learned are academic high achievers (Martín et al., 2008). Thus, although performance in sport and performance in academia seem to be composed of different interacting factors, the role of self-regulatory skills appears relevant for achieving performance in both domains.

Self-efficacy and effort play their own part in the relationship between self-regulatory skills and academic performance as students must be willing to make the effort and must have confidence in their ability to achieve their academic goals (Bandura, 1997). In this perspective, there will always be students with relatively low levels of self-efficacy affecting their performance, and students who could reach their goals but simply don't want to. Notwithstanding this, athletes who spend more time in sports training have to repeat a full year of study less frequently and are more motivated to achieve the highest grades feasible (Jonker, Elferink-Gemser, & Visscher, 2011).

In sum, elite youth athletes perform better in secondary school than the national average of students in the Netherlands, which may be related to their increased use of self-regulatory skills within and between performance domains such as sports and academia. Based on chapters 3 to 6, we suggest that encouraging athletes and students to utilize their self-regulatory skills within and between performance domains may help them to balance their activities better and may also foster better achievements.

Self-regulatory skills and development of expertise in sports

Even though athletes who took part in individual sports outperformed their peers playing team sports on planning and effort at the highest competitive levels (chapter 7), chapter 6 shows reflection to be most strongly allied to competitive level as differences between non-athletes, regional athletes and elite youth athletes were observed. Chapters 7 to 9 extend these results by showing that reflection seems to be the key factor in the development of sport expertise. Junior internationals differentiate themselves from nationals on their increased use of reflection (chapter 7) and reflection at junior level is suggested to have predictive value for those attaining senior international status (chapters 8 and 9). Specifically, the increased capacity of later senior internationals to use prior experiences, to set goals of improvement accordingly, and to reach these goals in an innovative manner

to outdo their competitors seem important already at junior level. Specifically, Zimmerman's (2000) sub-processes of self-evaluation (i.e., comparisons of self-observed performance against some standard) and adaptive inferences (i.e., adapting one's behavior and decisions to use previous performances to improve next time) appear to distinguish best between the later senior internationals and later senior nationals (chapter 8). Nevertheless, the sub-process of causal attributions (i.e., classifying causes of success and failure) is considered important as well, as shown by mean scores above 4.00 on items 2 and 5 in chapter 8 and 9.

By matching the later senior internationals with senior nationals on age, training hours per week, years of sport experience, and specific sport at junior level, chapter 8 shows that the later senior internationals display higher reflective scores 2.5 years before the moment of transition, thus when they were juniors. Chapter 9 extends these results by revealing stability in the later senior internationals' and senior nationals' scores on reflection in the 4-year period leading up to transition to senior level. However, the reflective scores of the later senior internationals were already significantly higher four years before transition and these differences remained significant up to the moment of transition.

In addition, the ability to reflect, and subsequently to take responsibility for the learning process instead of relying on the structure of coaches, appears to become increasingly important towards the moment of transition. The results from chapter 9 show that 50% of the junior internationals who decreased in competitive level decreased at the moment of transition and therefore become senior nationals. We suggest, in line with MacNamara and Collins (2010), that athletes should be prepared for the transition to senior level and the use of self-regulatory skills may help them. In this perspective, we recommend that coaches involve their athletes in the process of goal-setting and feedback from a young age instead of trying to impose their performance standards on the athlete. This autonomy-supportive way of coaching is assumed to stimulate young athletes to develop reflection skills, from which they benefit not only during their talent years (chapter 7), but also towards the moment of transition (chapter 9; MacNamara & Collins, 2010; Van Ark et al., 2010).

We also recommend that coaches approach their athletes individually to stimulate them to use reflective thinking. This thesis shows that, although junior and senior internationals possess high levels of reflection as a subgroup, some internationals report using reflective thinking relatively rarely, as expressed by the range in scores and standard deviations (Table 2 in chapter 7; Figure 1a and Table 4 in chapter 9). On the one hand, athletes with relatively low levels of reflection should be stimulated to use reflective thinking. On the other hand, the very best athletes seem not to be satisfied with just meeting the demands of the commonly established standards in their sport and make use of reflective thinking even more, as they are continuously looking for new ways to reinvent themselves. In addition, based on athletes' prior experiences and personal strengths and weaknesses, the achievement goals set in order to make progression differ as well. More specifically, every individual has his or her own personal characteristics, and is considered to be part of a personal environment (e.g., coach, peers, parents, school). Based on the tenets of the dynamical systems

theory (Newell, 1986), sport performance is ultimately composed of several interacting factors such as the task, multidimensional performance characteristics in sport and the environment (Elferink-Gemser, Visscher, Lemmink, & Mulder, 2004). During these interacting stages, elite youth athletes are limited in the amount of time each has before the moment of transition to senior competition. Furthermore, the age at which athletes need to make this transition differs between sports.

In this perspective, a sport-specific, or developmental-phase-centered approach which takes the age of transition into account is assumed to be worthwhile in talent development research. As shown in chapter 9, there are relatively large differences in the age of transition of elite youth athletes between dissimilar sports, for example between female gymnasts and male handball players (Table 3 in chapter 9). Elite youth athletes in 'early specialization sports' are supposed to reach their physical peak performance at a relatively young age. However, this means that they are also supposed to display high levels of reflection at a young age, despite being assumed to be less capable of using self-knowledge and past experiences for reflective objectives from a neuro-developmental perspective (Sebastian et al., 2008). Even though results from chapter 9 show that the female gymnasts and female swimmers indeed display relatively high scores on reflection, and that these scores are similar to the reflective scores of elite youth athletes in other sports who are older, but with just as many years to go to the moment of transition (chapter 9), one might wonder what this means for the role played by participation in elite sports from a young age related to the development of reflection, how these high levels of reflection are related to elite youth athletes' academic level in primary school, and whether these levels of reflection play a part in being selected for a talent development program.

Although the exact role of reflection in being selected for a talent development program at international level is unclear, staying selected for this program and making a successful transition to senior competition goes beyond that. Chapters 8 and 9 showed that 28% to 35% of the junior internationals and nationals change in competitive level during their road to the top, and that the ability to attain senior international status seems to be related to athletes' use of reflection. Moreover, approximately 15%-25% of the elite youth athletes who became senior internationals were competing nationally as juniors (chapters 8 and 9). This is worth noting as even though the Dutch competition structure is supposed to be well organized, and high quality coaches are present at least at junior international and junior national level, training facilities and provisions at school to combine extensive investments in sport with education are frequently based on athletes' current performance levels. More specifically, those who are selected for an international talent development program may receive even better training facilities (Baker, Horton, Robertson-Wilson, &Wall, 2003). Coaches, but also policy-makers in youth sports, need to be aware of this phenomenon and of the importance of scouting for athletes on future athletic potential and select athletes accordingly. In recent decades, this importance has already been established by studies examining the relative age effect in sports. These studies showed that elite youth athletes who are born relatively early in relation to the cut-off date, or those who mature early, are selected more often as they are physically more grown-up,

which favors their athletic performance (Helsen, van Winckel, & Williams, 2005). The ability to recognize youth athletes' potential may further extend the role of reflection in being selected.

In sum, reflection is considered a key factor in the development of sport expertise. Those athletes who displayed the highest levels of reflection attained senior international status more frequently, regardless of junior competitive level. The process of reflection differs between athletes and becomes increasingly important towards the moment of transition. Coaches are challenged to develop ways to encourage elite youth athletes individually to use reflective thinking in order to fulfill their full potential as athletes and to make a successful transition to senior level.

Theoretical considerations

Although not theoretically determined, this thesis contradicts leading stereotypes suggesting a negative link between elite youth sports and academic achievement. Elite soccer players especially are often designated as inferior students lacking motivation for and interest in other things in life than soccer. Nevertheless, elite youth athletes perform better at secondary school than the national average of students in the Netherlands, which may be related to their increased use of self-regulatory skills within and between sports and academia.

Chapter 6 sheds light on the causality question of whether elite youth athletes are able to compete at a high competitive level because of an innate ability to self-regulate, or whether they have developed their self-regulatory skills as a consequence of being active in elite sports. Even though high quality intervention studies really put this question to the test, the results of this thesis reveal clear developmental trends in the relationship between sports participation, measured by number of training hours per week, and development of planning, self-monitoring, reflection, effort and self-efficacy. In more concrete terms, those who trained more displayed higher self-regulatory scores and had better academic performances (chapter 6; Jonker et al., 2011). The relationship between sports participation and cognition has also been established in other domains of research, for example in children with learning disabilities (e.g., Hartman, Houwen, Scherder, & Visscher, 2010; Westendorp, Hartman, Houwen, Smith, & Visscher, 2011), favoring those who take part in sports. This comes as no surprise as training at a youthful age should be considered as a learning process focusing on the development of new skills (Côté, 1999). Furthermore, our results extend theories of transfer by showing that elite youth athletes are often part of the preuniversity system and display frequent use of self-regulatory skills. Utilizing these skills is suggested to help elite youth athletes in combining a sport career with education.

This thesis further contributes to the possibility of measuring the learning potential of youth between 12 and 18 years of age. This is interesting as through continuous research in the field of talent development, we seem better and better able to distinguish those athletes who are athletically more gifted than others at a specific age, but still struggle to determine which athletes have the most potential to become future internationals. The potential of athletes to learn and improve, for example by using reflection, turned out to be an important predictor for athletes who have improved their sport-specific skills (e.g., physiological, technical, tactical; Huijgen, Elferink-Gemser, Post, & Visscher, 2009; Kannekens et al., epub ahead of print; Roescher, Elferink-Gemser, Huijgen, & Visscher, 2010) enough to make it to senior international level. It should be acknowledged, however, that the elite youth athletes in the present study had already been identified as talented in the opinion of coaches as they were all part of a talent development program. Nonetheless, the formulas presented in chapter 6 and the model in chapter 9 can still be used to mirror an athlete's use of self-regulatory skills with the average of same-age peers (Chapter 6), or related to an athlete's road to senior competitive status (chapter 9).

The value of taking an individual approach in the field of talent development is emphasized as well. Not only do athletes differ in their use of reflective thinking, they all have personal characteristics and operate in individual environments that interact as a dynamical system (Newell, 1986). Special attention is placed in chapter 9 on the environmental aspects of differences between sports at transition age. Research on elite youth sports should therefore be conducted in agreement with the developmental phases determined by the sport instead of relying on chronological age.

Further, we add to the foundations of the deliberate practice theory (Ericsson, Krampe, & Tesch-Römer, 1993). In line with the assumption that athletes have to spend extensive numbers of hours on deliberate training over a period of at least 10 years, the athletes in this thesis indeed invested numbers of hours that came close to 10,000. Furthermore, athletes had approximately 10 years of experience in their sport at the moment of transition. We therefore agree with prior research that investing these large numbers of hours on training is a necessity for elite youth athletes to attain senior international status, but also with Ericsson's (2003) proposition that cognitive involvement is necessary in order to attain higher levels of performance, as was shown in this thesis by the increased use of reflection by the senior internationals.

Limitations and recommendations for future research

As mentioned above, the elite youth athletes in the present study had already been identified as talented. Although we included the possible influence of chronological age as a covariate or interaction term in all our chapters, the effect of being selected could not be controlled for. Furthermore, all elite youth athletes were in secondary schools with a track offering them special provisions such as flexibility in school timetable, more time for homework, suspension or adaptations of periodic exams to counteract delay incurred by training and games, and supervision by a mentor (Stichting LOOT & Sardes, 2001). Although we assume that working on performance improvement every day, which is the case for elite youth athletes, will have more impact on the use of self-regulatory skills, and that regular secondary schools provide their elite youth athletes with special provisions as well, the influence of being part of a school with such special provisions is unknown.

Another limitation is related to the fact that we present a rationale for why elite youth athletes and regional athletes may benefit from the time they spend on training related to their development of self-regulatory skills; however, we did not assess the relationship with aspects of goal-setting and feedback. This is an important recommendation to be examined in future research and to include when examining the effects of intervention

studies in sports.

Furthermore, a self-report questionnaire was used to examine differences in self-regulatory skill use. Although sufficient validity and reliability measures for 11-to-17-year-old youth has been found (chapter 10), there is discussion as to whether people in general are able to report their thoughts properly without being susceptible to giving socially desirable answers (Eccles, in press; Young & Strakes, 2006). Although we assume that specifically elite youth athletes must be capable of answering these questions adequately as they work on performance improvement every day and therefore may have a realistic idea about their learning process, the limitations of using a self-report questionnaire should be acknowledged when interpreting our results. In addition, what we know from these results is how often athletes say they use self-regulatory skills, but what they self-regulate and why they select a specific step from a range of possibilities to improve remains unclear. More qualitative studies are therefore suggested for future research adopting a more holistic perspective. To elaborate, prior research showed that elite youth athletes operate in their own personal environment in which they are faced with challenges at psychological, psychosocial, athletic and academic levels which may affect their performance (Wylleman, Alfermann, & Lavallee, 2004). The ability to reflect may help them to overcome the stress accompanied by those challenges, and the ability to look beyond the established scope may improve athletes' performance (Aspinwall & Taylor, 1997; Mezirow, 1991; Moon, 2003).

In this thesis, a positive relationship between self-regulatory skill use and performance is frequently cited. However, too much self-regulation may lower performance outcomes. However, to the author's knowledge, no studies have assessed the possible effects of this phenomenon. Furthermore, this thesis focused on the role of self-regulation in the relationship between sports and academia and emphasizes the value of sports participation for the development of self-regulatory skills. However, not all 12-to-18-year-olds like sports or will experience fun and success. Although not examined, one of the rationales in this thesis of why sport participation may be beneficial is related to athletes' familiarity with goal-setting and feedback. These aspects are present in other performance domains as well such as in music, drama and art. Prior research on music has already established that musicians striving to make a living use self-regulatory skills frequently (Nielsen, 2001).

Conclusions

The aim of this thesis was twofold: 1) to assess the development and use of self-regulatory skills in elite youth athletes in the relationship between sport and academic performance, and 2) which self-regulatory skills were most frequently used by the best athletes and can determine who will become a senior international in the future. In an attempt to answer these questions, and based on the results of this thesis, we conclude that:

- Elite youth athletes are academic high achievers.
- Elite youth athletes report more frequent use of self-regulatory skills and these skills may foster their sport and academic performances.
- Spending a substantial number of hours per week on training is beneficial for the development of self-regulation, regardless of the level at which sport is played, but must be guided by qualified trainers.
- Reflection is considered to be a key factor in the development of sport expertise and has predictive value for those who have the best chance of attaining senior international status.
- Reflection specifically becomes important closer to the moment of transition, and in guiding elite youth athletes towards this moment an individual approach should be adopted.

Implications for sports practice, education and development of expertise

These conclusions have some practical implications for trainers, coaches, talent scouts, teachers, policy-makers, mainstream students and athletes striving to reach the top. Trainers, coaches and talent scouts should be aware of the importance of reflective thinking during development and of their role as coaches to stimulate athletes to set improvement goals and to use reflection accordingly. They should identify those athletes with high and relatively low levels of reflection as juniors and support those reporting low levels to develop reflective thinking, specifically to prepare them for the moment of transition. Autonomy-supportive coaching in which athletes become involved in the process of goal-setting and feedback and taking athletes' developmental phases into account seem most advantageous. Athletes with high levels of reflection should be trusted by the coach and coaches should let them take responsibility for their own learning process. Furthermore, athletes should be stimulated to use their reflective thinking skills outside the sport environment as well. So, trainers and coaches are challenged to develop ways to support elite youth athletes to use reflective thinking to fulfill their full potential as athletes and students. Furthermore, they should be aware that junior nationals with high levels of reflection may still be able to make the transition to senior international level and therefore look further than their own selection. Last but not least, the importance for athletes to reflect on their own abilities should be acknowledged.

For teachers, the most important findings are related to the fact that physical education classes can be used to develop self-regulatory skills. Teachers can help students to use self-regulatory skills between performance domains simply by knowing whether their students play sports, what other hobbies they have, how they perform at school and by asking them questions on how to combine these domains in a autonomy supportive way.

Policy-makers should be aware of the major benefits of sports for cognitive development in youth. Children need to have access to sports for a substantial number of hours per week from an early age. These hours should be incorporated into the physical education classes in primary and secondary schools, and children should be provided

with qualified sport teachers or trainers who stimulate them to develop and use self-regulatory skills.

Mainstream students should be conscious of the benefits of using their self-regulatory skills within and between performance domains. It may help them to exert more control over their learning process and to benefit from the time they spent on learning. They should develop these skills within their own domain of expertise, which need not necessarily be sport.

Elite youth athletes must be aware of their own strengths and weaknesses, prior experiences and of setting improvement goals accordingly. The careers of several successful sports-men underline the value of reflection during training and competition. Ruud van Nistelrooy, for example, kept an exercise book in which he noted down important instructions received from his coach. Epke Zonderland knows exactly what to do to win a gold medal and is able to decide during competition to change his high bar event based on competitors' performances and his personal abilities. Further, elite youth athletes should also be aware of their well-developed sense of self-regulation and how it can also further their performance in academia, but probably also after their athletic career, later in life.

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Summary / Samenvatting

Summary

This thesis assessed the relationship between the sport and academic performances of 12-to 18-year-old youth. The results showed that elite youth athletes are more often present in the pre-university academic system when compared with their less athletically gifted peers. Elite youth athletes' use of self-regulatory skills is suggested to be important in the relationship between sport and academic performances as self-regulative learners are considered to learn more efficiently. This means that elite youth athletes are generally highly aware of how to approach their learning to improve by using prior knowledge and experiences for future actions, by setting improvement goals and by acting accordingly. Specifically reflection as part of self-regulation appears to be important for elite youth athletes. Moreover, the ability to reflect upon previous actions and performances may help to predict who has the most potential to reach the top. In addition, even though no causality questions (i.e., have athletes who reached the top and score high on reflection developed their reflective thinking through sport or do they possess an innate ability to reflect) can be answered solely based on the results of the present thesis, it suggests that those being active in sports may benefit from their participation as the sport environment seems highly suitable to develop self-regulatory skills due to its goal-setting and feedback-oriented character.

Chapter 1 outlined what it takes for elite youth athletes to commit to their dream to reach the top in sports. To be able to become one of those athletes that millions of people are watching at during important global games such as the Olympics or World Championships, elite youth athletes need to invest extensive numbers of training hours in a period that is also charactarized by pressure at school. In this chapter, the definition and value of self-regulatory skills in this context has been concisely discussed. Furthermore, the purpose of this thesis to assess the role of self-regulatory skills in the sport and academic performances of elite youth athletes between 12 and 18 years, but also in typical students has been presented.

In chapter 2, existing theories on self-regulation are reviewed. The purpose of this chapter was to examine whether self-regulatory skills may serve as an underlying feature for performance in sport and academia, and whether there are differences between self-regulatory skills that contribute most to performance in sports or academia. This chapter shows that although differences exist in concept, definition and measurement between studies, all concepts seemed to be based on the general assumption that learners must be able to set specific and perso-

nal attainment goals that are based on prior experiences in order to improve and are, therefore, considered to be in general agreement with Zimmerman's definition of self-regulated learning. According to Zimmerman, self-regulative learners are metacognitively, motivationally, and behaviorally proactive participants in their own learning process. They use prior knowledge and experiences to set learning and improvement goals accordingly, make a planning before performance, monitor progression during performance, and evaluate the process and results afterwards. Furthermore, learners must be willing to make an effort to improve and must believe in their ability to improve. Zimmerman's self-regulated learning theory has been applied to studies in sport and academia separately and showed that those who were considered to be high achievers in sport or academia reported to use their self-regulatory skills more frequently. Even though the exact development of self-regulatory skills at school age remains unclear, the possibility for transfer of these skills between sports and academia has been suggested, specifically when youth has reached the age of 12. With regard to the last aim of this chapter, results of the literature showed that self-monitoring and reflection were predictive for academic achievement, whereas reflection, effort and self-efficacy were most important in the sport setting.

Chapter 3 and 4 show that elite youth athletes are actually performing better at school than typical students, despite of prevailing stereotypes of elite youth athletes being low academic achievers in the past, and which is still guiding with respect to professional soccer. This is demonstrated by the fact that elite youth athletes are more frequently enrolled in the pre-university system than is the typical student and that participation in these high types of education is not accompanied by other difficulties such as repeating class or an unsatisfactory average. Worth noting in a historical perspective is the finding that today's elite youth athletes are even more frequently part of the pre-university system than their elite youth peers 14 years ago (chapter 3). All together, this chapter posits the possibility for self-regulatory skills to be a promising venue for further investigation in the relationship between sport and academic performance.

The results of chapters 4 and 5 confirmed the propositions of chapter 3 that self-regulatory skills may be underlying in the relationship between sports and academia. These chapters showed rather similar scores between pre-university and pre-vocational elite youth athletes, whereas pre-university typical students had significantly higher self-regulatory scores than the pre-vocational typical student. Moreover, elite youth athletes in the pre-vocational system outscored their pre-university typical peers on reflection and effort. This implies that they are more aware of their own strengths and weaknesses and how to approach their learning. Besides that they are more willing to make an effort to reach their goals. Based on these findings it is suggested that taking part in elite youth sports fosters the development and use of self-regulatory skills as these skills were more pronounced in elite youth athletes when compared to typical students, regardless of academic level.

These findings are in line with those in chapter 6 in which the development of self-regulatory skills is assessed related to sport, academic, and/or more general characteristics. Reflection and effort turned out to be most related to competitive level in sport. This implies that athletes who play sports at higher competitive level increased in their reflective scores between 12 and 17 years of age whereas the reflective scores of those who play sports at lower competitive level remain stable in this period. In addition, the levels of effort of those competing at high competitive level decreased less than the levels of those who compete at lower level. With respect to academia it was found that the pre-university students outscored their pre-vocational peers on self-monitoring, evaluation and self-efficacy and that the scores of the pre-university students increased between 12 and 17 years. Furthermore, the results from chapter 6 showed that those athletes who trained more, regardless of the competitive level at which sports is played, had higher scores on planning, self-monitoring, reflection, effort and self-efficacy than athletes who devoted less time to training or did not participate in sports at all and the scores of those who trained more increased between 12 and 17 years of age. This implies that spending a substantial number of hours per week on training is beneficial for the use of self-regulatory skills.

Chapters 7 to 9 focus on self-regulatory skills in a talent development perspective. Chapter 7 adresses the question if and which self-regulatory skills can distinguish between junior internationals (the best) and junior nationals (the good) taking possible differences of type of sport into account. With respect to type of sport, the results show that athletes taking part in individual sports (e.g., tennis, speed-skating) have higher scores on planning and effort than the athletes playing team sports (e.g., volleyball, basketball) and differences between types of sport seem to become more evident at higher competitive level. With regard to differences between junior internationals and junior nationals, the junior internationals reported to use reflection more frequently than their nationally competing peers. This implies that the junior internationals are better able to set improvement goals based on prior information, experiences and their own strengths and weaknesses to improve, thereby maximizing performance improvements.

In chapter 8, the predictive value of reflection is assessed. More specifically, this chapter addresses the question whether elite youth athletes' use of reflection 2.5 years before the transition from junior to senior competitions may predict future competitive level. The results showed that athletes who reached senior international status had higher scores on reflection 2.5 years before the transition. In this perspective junior competitive level did not play a part, as junior nationals who became senior internationals, and thereby increased in competitive level, had similar scores on reflection as the junior internationals who continued as internationals. This was also the case for the junior athletes who decreased in competitive level as their scores were similar to the junior nationals who became senior nationals. These changes in competitive level were observed for 35% of the elite youth athletes indicating that they were not in the athletic track leading to their attained senior competitive level and a relationship with the use of reflection is suggested.

Chapter 9 extends these results in a development perspective. In this chapter, the scores on reflection of junior internationals and junior nationals were assessed in the four-year period before transition from junior to senior competitions. Measurements were taken on a yearly basis which made it possible to not only draw conclusions with respect to the predictive value of reflection, but to also assess its development during these talent

years. The results showed that reflection remained stable in the four-year period before transition for those who finally achieved senior internationals status as well as for those who became senior nationals. However, those who became senior internationals had higher reflective scores than those who became nationals, once again with junior competitive level not playing a part. Twenty-eight percent of the elite youth athletes were not in the athletic track leading to their attained senior competitive level. Those who decreased in competive level from junior international to senior national level had relatively low scores on reflection and 75% of them decreased in competitive level late in their talent years (i.e., year before or moment of transition). Those who increased in competitive level from junior national to senior international level had high scores on reflection and 30% of them increased in competitive level at the moment of transition. This implies that those elite youth athletes who are initially identified as being physically less gifted, but score high on reflection are frequently able to improve enough to ultimately become a senior international. Thus, those athletes who know best which aspects to improve during training and competition and to set personal improvement goals accordingly by means of reflection are more frequently able to attain senior international status. We therefore propose that reflection can help to predict which athletes have the best potential to attain senior international status already four years before transition.

As this thesis is based on the results of the Self-Regulated Learning – Self-Report Scale (SRL–SRS), chapter 10 adresses the validity and reliability of this questionnaire. The results of two confirmatory factors analyses supported the construct validity and the analyses of reliability showed that the instrument is reliable as well. It is therefore concluded that the SRL–SRS is an appropriate and useful tool for the assessment of self-regulatory skills in 12-to 17-year-old youth.

In the general discussion in chapter 11, main findings, implications and recommendations for future research of this thesis are presented. To summarize, the purpose of this thesis was twofold: 1) to assess the development and use of self-regulatory skills in elite youth athletes in the relationship between sport and academic performances (chapters 3 to 6), and 2) which self-regulatory skills were most frequently used by the best athletes and can help to predict who will become a senior international in the future (chapters 7 to 9).

In conclusion

The following conclusions are drawn and give an answer to the main propositions of this thesis:

- Elite youth athletes, including soccer players, are academic high achievers.
- More frequent use of self-regulatory skills is reported by elite youth athletes than by athletes competing at lower competitive level or non-athletes. The use of self-regulatory skills may foster sport and academic performances.
- Spending a substantial number of hours per week on training is beneficial for the development of self-regulatory skills, irrespective of the level at which sports is played by the athlete.
- Reflection, which refers to the use of prior knowledge and experiences to improve future performance and to set attainment goals accordingly, is considered to be a key factor for sport expertise and has predictive value for those who have the most potential to reach the top.
- Reflection seems to become specifically important closer to the moment of transition and in guiding elite youth athletes an individual approach should be adopted.

Both those working with youth, but also students and athletes themselves should be aware of the beneficial effects of using self-regulatory skills and how it develops and can be used to further performances in academia, sports, and probably also later in life.

Samenvatting

In dit proefschrift is gekeken naar de relatie tussen sport- en schoolprestaties van jongeren in de leeftijd van 12 tot 18 jaar. De resultaten laten zien dat sporttalenten vaker dan leeftijdsgenoten die niet als talent zijn aangemerkt een schoolopleiding volgen op havo of vwo niveau. De reden voor het hoge percentage havo en vwo leerlingen onder de sporttalenten wordt gezocht in het gebruik van zelfregulatie door deze jonge atleten. Dit betekent dat sporttalenten door het gebruik van zelfregulatie efficiënter leren doordat zij zich meer bewust zijn van het eigen leerproces, vaker kennis en ervaringen uit het verleden gebruiken om ervan te leren, en beter in staat zijn om op basis van deze informatie persoonlijke doelen te stellen om te verbeteren. Vooral reflectie (een van de vaardigheden die onder zelfregulatie valt) blijkt onderliggend aan de prestaties van sporttalenten en kan gebruikt worden om te voorspellen welk talent de meeste kans maakt om de top te halen in de sport. Ondanks dat dit proefschrift geen uitsluitsel kan geven of sporttalenten de hoge mate van reflectie hebben aangeleerd in de sport of dat zij hiermee geboren zijn, wijzen de resultaten van dit proefschrift in de richting van de voordelige effecten van sportdeelname (ongeacht niveau) op de ontwikkeling van zelfregulatie. De sportcontext lijkt uitermate geschikt voor deze ontwikkeling omdat jongeren tijdens het sporten spelenderwijs kennis maken met het stellen van doelen en continue feedback krijgen van de omgeving en de trainer.

In hoofdstuk 1 wordt een korte beschrijving gegeven wat het betekent voor sporttalenten om hun droom na te jagen om de top te halen in de sport. Om uiteindelijk een van de atleten op de Olympische Spelen of tijdens WK's te mogen zijn, moeten zij veel tijd besteden aan trainen in een periode waarin ook de schoolprestaties belangrijk zijn. De definitie en de mogelijke rol van zelfregulatie in deze combinatie tussen sport en onderwijs wordt in dit hoofdstuk kort besproken. Daarnaast wordt het uiteindelijke doel van dit proefschrift gepresenteerd, namelijk om de rol van zelfregulatie in kaart te brengen in de relatie tussen sport- en schoolprestaties bij sporttalenten in de leeftijd tussen 12 en 18 jaar, maar ook bij reguliere jeugd van dezelfde leeftijd.

Hoofdstuk 2 omvat een literatuuronderzoek naar deze relatie. Wetenschappelijke literatuur uit de afgelopen 15 jaar is samengevat om de mogelijkheid te onderzoeken of zelfregulatie onderliggend zou kunnen zijn aan de goede prestaties van sporttalenten op school. De resultaten van het literatuuronderzoek laten zien dat er veel

verschillen zijn in de wijze waarop zelfregulatie is onderzocht, maar dat allen uitgaan van de noodzaak om doelen te stellen die het beste passen bij de persoonlijke sterke en zwakke kanten en de leerwens. Deze opvatting komt overeen met Zimmerman's definitie van zelfregulatie, namelijk dat zelfregulatief leren wordt bepaald door de mate waarin men metacognitief, motivationeel en gedragsmatig proactief deelneemt aan het eigen leerproces. Dit betekent dat op basis van kennis en ervaring uit het verleden een leerdoel wordt bepaald (reflectie), voorafgaand aan het leren een planning wordt gemaakt (plannen), dat tijdens het leren wordt gekeken of men nog op schema ligt (monitoren), dat het leerproces en de prestatie naderhand worden geëvalueerd (evaluatie). Daarnaast is het belangrijk dat men gemotiveerd is om te willen leren en verbeteren (inzet) en dat men vertrouwen heeft in het eigen kunnen en een goede uitkomst (self-efficacy). Deze zelfregulatie theorie van Zimmerman is al toegepast zowel in de sport als op school. In beide domeinen bleek succes samen te hangen met een hogere mate van zelfregulatie, maar de mogelijkheid voor het gebruik van zelfregulatie tussen de twee domeinen bleek niet onderzocht. Ook de ontwikkeling van zelfregulatie is nog niet eenduidig in kaart gebracht, maar men gaat er vanuit dat kinderen vanaf een leeftijd van 12 jaar in staat zouden moeten zijn om gebruik te maken van zelfregulatieve vaardigheden tussen domeinen.

Hoofdstuk 3 en hoofdstuk 4 laten zien dat de relatie tussen sport en schoolprestaties ook echt blijkt te bestaan. Ondanks dat in het verleden vaak is gedacht dat topsport en onderwijs niet goed samengaan en dat voetballers nog steeds kampen met het vooroordeel dat zij 'dom' zijn, blijken sporttalenten (inclusief voetballers) vaker dan reguliere leerlingen een opleiding te volgen op havo of vwo niveau zonder dat zij vaker blijven zitten of slechtere cijfers halen. Een interessant gegeven uit hoofdstuk 3 is dat sporttalenten over de jaren heen beter zijn gaan presteren op school. Meer specifiek zit de huidige groep sporttalenten vaker op de havo of het vwo dan hun getalenteerde leeftijdsgenoten 14 jaar geleden. De resultaten van dit hoofdstuk wijzen op een mogelijke rol van zelfregulatie in dit geheel.

De resultaten in hoofdstuk 4 en 5 onderstrepen bovengenoemde suggestie. Sporttalenten binnen de havo en het vwo hebben ongeveer gelijke scores op zelfregulatie als sporttalenten binnen het vmbo. Echter, de scores van reguliere havo of vwo leerlingen zijn wel degelijk hoger dan die van reguliere leerlingen op het vmbo. Dit effect wordt verklaard door de relatief hoge scores van de vmbo sporttalenten op zelfregulatie. Wanneer we hun scores vergelijken met die van reguliere havo of vwo leerlingen scoren zij zelfs hoger op de vaardigheden reflectie en effort. Dit betekent dat zij zich meer bewust zijn van het eigen leerproces en eerdere kennis en ervaringen op basis waarvan zij het leerproces inrichten. Daarnaast zijn zij meer bereid om inspanningen te leveren om de gestelde doelen ook echt te behalen. Deze resultaten suggereren dat er een relatie bestaat tussen sportdeelname (op hoog niveau) en de ontwikkling van zelfregulatie aangezien de zelfregulatieve vaardigheden van sporttalenten beter ontwikkeld zijn dan die van reguliere leerlingen waarin schoolniveau een onderschikte rol speelt.

Vergelijkbare resultaten zijn gevonden in hoofdstuk 6. Dit hoofdstuk focust zich op de ontwikkeling van zelfregulatieve vaardigheden in jongeren tussen de 12 en 17 jaar waarbij rekening is gehouden met sport-

niveau, aantal trainingsuren, schoolniveau, zittenblijven en meer algemene factoren die de ontwikkeling van zelfregulatie kan beïnvloeden. Uit hoofdstuk 6 blijkt dat reflectie en inzet het meest samenhangen met sportniveau. Meer specifiek steeg het gebruik van reflectie van sporttalenten in de leeftijd van 12 tot 18 jaar terwijl dat van reguliere sporters en niet-sporters gelijk bleef. Daarnaast daalden de scores op inzet van de sporttalenten minder sterk dan de scores van de andere twee groepen in deze leeftijdsperiode. In relatie tot schoolprestaties lieten de resultaten zien dat jongeren die een opleiding volgen op havo of vwo niveau in toenemende mate monitoren en evalueren en meer vertrouwen hebben in het eigen kunnen (self-efficacy) tussen 12 en 17 jaar en dat hun scores hoger zijn dan die van leeftijdsgenoten op het vmbo. Daarnaast blijken jongeren die meer tijd besteden aan sport per week zich meer bewust van de eigen sterke en zwakke kanten op basis waarvan een planning gemaakt wordt, meer te monitoren tijdens het leren en hebben zij ook meer inzet en vertrouwen gedurende het leerproces dan jongeren die minder tijd besteden per week aan sport. Deze resultaten staan los van het niveau waarop gesport wordt en het gebruik van bovengenoemde zelfregulatieve vaardigheden neemt toe naarmate ze ouder worden. Concreet betekent dit dat sportdeelname in uren per week voordelig lijkt te zijn voor de ontwikkeling en het gebruik van zelfregulatie.

Bovenstaande hoofdstukken dragen bij aan discussies die de meerwaarde van sportdeelname onderstrepen op de leerprestaties van jongeren. De hoofdstukken 7 tot en met 9 focussen meer op de rol van zelfregulatie voor de ontwikkeling van talent in sport. Hoofdstuk 7 richt zich hierbij op de vraag of en welke aspecten van zelfregulatie onderscheidend zijn tussen sporttalenten op het hoogste (jeugd internationals) en op een na hoogste (sporttalenten in regionale selecties) niveau. In de analyses in hoofdstuk 7 is bewust rekening gehouden met het type sport (team of individueel) waarin de sporttalenten actief zijn. Met betrekking tot deze factor scoren sporttalenten in individuele sporten zoals tennis en schaatsen hoger op planning en inzet dan sporttalenten die een teamsport beoefenen (bijvoorbeeld volleybal en basketbal). De verschillen tussen individuele en teamsporters worden groter naarmate het sportniveau hoger wordt en lijken verklaard te kunnen worden door verschillen in de aard van de sport. Wanneer we kijken naar verschillen op zelfregulatie tussen de jeugd internationals en de sporttalenten in regionale selecties blijken de jeugd internationals meer te reflecteren op het eigen leerproces en de prestaties dan de sporttalenten in regionale selecties. Dit betekent dat de jeugd internationals beter in staat zijn om persoonlijke doelen te stellen gebaseerd op eerdere kennis, ervaringen en de eigen sterke en zwakke punten waardoor zij efficiënter leren en dus meer leren in dezelfde tijd.

In hoofdstuk 8 wordt gekeken of reflectie een voorspeller kan zijn voor welke sporttalenten uiteindelijk de top zullen gaan halen. In dit hoofdstuk zijn de scores op reflectie van senior internationals en senioren die uitkomen op landelijk niveau met elkaar vergeleken op het moment dat zij junior waren en nog 2,5 jaar te gaan hadden tot de overstap naar de senioren. De resultaten laten zien dat degenen die uiteindelijk internationals zijn geworden hoger scoorden op reflectie dan degenen die uiteindelijk niet zijn geselecteerd om Nederland te vertegenwoordigen tijdens internationale evenementen zoals EK's, WK's en de Olympische Spelen en

dat dit los staat van het sportniveau dat zij als junior hadden. Meer specifiek bleken sporttalenten in regionale selecties die in staat waren om genoeg te verbeteren om uiteindelijk een senior international te worden vergelijkbare scores op reflectie te hebben als jeugd internationals die ook senior internationals zouden worden. Een vergelijkbaar resultaat werd gevonden voor de jeugd internationals die uiteindelijk niet de internationale senioren top hebben gehaald. De scores op reflectie voor deze groep dalers in sportniveau was vergelijkbaar met de groep sporttalenten in regionale selecties die uiteindelijk ook landelijk zullen blijven sporten als senioren. In totaal bleek 35% van de sporttalenten nog te wisselen in sportniveau tussen hun jaren als talent en het uiteindelijke senioren niveau. Relaties met het gebruik van reflectie lijken evident.

Hoofdstuk 9 borduurt voort op deze bevindingen en breidt ze verder uit door niet alleen de voorspellende waarde van reflectie te onderzoeken, maar ook de ontwikkeling van reflectie in de 4 jaar voordat sporttalenten de overstap moeten maken naar de senioren. De resultaten laten zien dat reflectie stabiel blijft in deze 4 jarige periode voorafgaande aan de overstap. De scores van de latere senior internationals zijn echter wel significant hoger dan die van de atleten die later op landelijk niveau zullen acteren. Wederom blijkt junior sportniveau (jeugd international of sporttalent in een regionale selectie) van ondergeschikt belang. In totaal wisselt 28% van de sporttalenten in deze 4 jarige periode nog van sportniveau waarbij het grootste percentage van de jeugd internationals daalt naar landelijk niveau een jaar voor, of op het moment van de overstap naar de senioren. Ongeveer een derde van de sporttalenten die stijgen in sportniveau van regionaal niveau naar senior internationaal niveau doet dit op het moment van de overstap. Dit betekent dat door goed te reflecteren sporttalenten die in eerste instantie zijn aangemerkt als minder talentvol zichzelf toch voldoende hebben verbeterd om uiteindelijk op internationaal niveau te kunnen acteren. Hoofdstuk 9 concludeert daarom dat sporttalenten die zich het meest bewust zijn van welke vaardigheden zij moeten verbeteren en aanwenden tijdens trainingen en wedstrijden en op basis hiervan persoonlijke doelen stellen (reflectie), vaker in staat blijken te zijn om door te breken en de top te halen. Het gebruik van reflectie is daarom een belangrijke voorspeller voor het behalen van de top, maar lijkt ook trainbaar.

Aangezien de resultaten van dit proefschrift verkregen zijn door gebruik te maken van de Self-Regulated Learning – Self-Report Scale (SRL–SRS) onderzoekt hoofdstuk 10 de validiteit en de betrouwbaarheid van deze vragenlijst. Verschillende analyses in dit hoofdstuk tonen aan dat zowel de construct en content validiteit even als 3 maten van betrouwbaarheid als voldoende kunnen worden beschouwd. Hierdoor is de SRL–SRS een geschikt en bruikbaar instrument om zelfregulatie in 12 tot 17 jarige jongeren te onderzoeken.

In hoofdstuk 11 worden de belangrijkste resultaten, de betekenis van deze resultaten en aanbevelingen voor toekomstig onderzoek besproken. Samenvattend was het doel van dit proefschrift om enerzijds de ontwikkeling en het gebruik van zelfregulatie in de relatie tussen sport- en schoolprestaties in kaart te brengen (hoofdstuk 3 tot en met 6) en anderzijds om aan te geven welke zelfregulatieve vaardigheden het meest bijdragen aan het verschil tussen de absolute top (internationals) en de atleten die dat niveau net

niet aankunnen, zowel voor junioren als voor senioren en de voorspellende waarde van zelfregulatie (hoofdstuk 7 tot en met 9).

Conclusies

Onderstaande conclusies zijn in hoofdstuk 11 gepresenteerd en sluiten aan bij bovengenoemde doelen:

- Sporttalenten (ook voetballers) presteren vaak goed op school.
- Sporttalenten maken vaker gebruik van zelfregulatie dan reguliere jongeren en dit gebruik lijkt voordelig te zijn voor hun prestaties in de sport en op school.
- Jongeren die meer sporten (ongeacht het sportniveau) hebben beter ontwikkelde zelfregulatieve vaardigheden dan jongeren die minder vaak of niet sporten.
- Reflectie blijkt een belangrijke bepaler en voorspeller voor het sportniveau van de atleet zowel op junioren als op senioren leeftijd.
- Reflectie lijkt belangrijker te worden richting het moment van de overstap naar de senioren en het is belangrijk om atleten op individuele basis richting deze overstap te begeleiden.

Dit proefschrift benadrukt daarom het belang voor zowel trainers en leraren die met jeugd werken als voor studenten en sporttalenten zelf om bewust te worden van de voordelige effecten van het gebruik van zelfregulatie. Ze kunnen hiervan profiteren in verschillende domeinen zoals in de sport, op school en waarschijnlijk ook later in het leven.

Curriculum Vitae and List of Publications

Curriculum Vitae

Laura Jonker is geboren op 31 maart 1984 te Bunnik. Na het behalen van haar vwo diploma aan het Bonifatiuscollege in Utrecht is zij in 2002 begonnen aan de studie Bewegingswetenschappen aan de RijksUniversiteit van Groningen. In 2005 heeft ze onderzoek gedaan naar de relatie tussen sportieve vaardigheden en leerprestaties van kinderen tussen 6 en 12 jaar in het speciaal basisonderwijs. Na het afronden van deze scriptie is zij begonnen met de masteropleiding aan dezelfde faculteit, waar ze in augustus 2007 is afgestudeerd. Haar afstudeeronderzoek naar de relatie tussen sport- en schoolprestaties bij sporttalenten in de leeftijd van 12 tot 16 jaar en de rol van zelfregulatie heeft plaatsgevonden als onderdeel van haar afstudeerstage bij NOC*NSF.

In september 2007 is Laura begonnen met haar promotieonderzoek bij Bewegingswetenschappen in Groningen op hetzelfde onderwerp als waarop zij is afgestudeerd. Tot 2011 heeft zij daar onderzoek verricht naar de schoolprestaties van sporttalenten, maar ook van sporters op regionaal niveau en van niet-sporters. Daarnaast heeft ze gekeken of er verschillen bestaan tussen groepen jongeren ingedeeld naar sportniveau en schoolniveau en hun gebruik van zelfregulatie. Naast haar werkzaamheden in het onderzoek heeft ze ook diverse bachelor- en masterstudenten begeleid tijdens hun afstudeertraject en is ze regelmatig uitgenodigd voor het geven van gastcolleges en workshops.

Sinds november 2010 is Laura eveneens werkzaam bij de KNVB in het kader van de Impuls Brede Scholen, Sport en Cultuur. Deze Rijksimpuls is erop gericht om middels de inzet van combinatiefunctionarissen meer kinderen kennis te laten maken met verschillende takken van sport tijdens- en naschools, in de wijk en bij de sportvereniging.

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